Draft Final
Chemical Warfare Material Sites Investigation Work Plan, Presidio of San Francisco, California

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List of Acronyms and Abbreviations

ASR	Archive Search Report
BEC	BRAC Environmental Coordinator
BRAC	Base Realignment and Closure
CAIS	Chemical Agent Identification Set
CESPD	US Army Corps of Engineers, South Pacific Division
CG	Phosgene
CN	Chloroacetophenone (riot control agent)
CS	Orthochlorobenzylidene Malononitrile (riot control agent)
CSM	Conceptual Site Model
CWM	Chemical Warfare Material
CWS	Chemical Warfare Service
DA	Department of the Army
DQO	Data Quality Objective
EE/CA	Engineering Evaluation/Cost Analysis
EOD	Explosive Ordnance Disposal
H	Mustard
HD	Distilled Mustard
IDW	Investigation Derived Waste
ITSI	Innovative Technical Solutions, Inc.
L	Lewisite
MEC	Munitions and Explosives of Concern
NCO	Non Commissioned Officer
OE	Ordnance and Explosives
PS	Chloropicrin
QM	Quarter Master
RCWM	Recovered Chemical Warfare Material
RI/FS	Remedial Investigation/Feasibility Study
SAP	Sampling and Analysis Plan
SI	Site Inspection
TEU	Technical Escort Unit (now the 20th Support Command)
USACE	US Army Corps of Engineers
USAEC	US Army Environmental Center
UXO	Unexploded Ordnance

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CHAPTER 1, INTRODUCTION

a. Project Authorization

The Base Realignment and Closure (BRAC) office authorized this project based on a request from the Presidio Trust. The US Army Corps of Engineers, South Pacific Division (CESPD) Range Support Center was tasked with the investigation.

b. Purpose and Scope

The purpose of this work is to confirm that no Chemical Agent Identification Set (CAIS) materials or Chemical Warfare Material (CWM) residues are present within the Presidio of San Francisco (hereinafter "Presidio"). The CAIS materials could include mustard, lewisite, phosgene, and chloropicrin. However, mustard is the most persistent agent of those commonly used for training and is therefore the focus of this investigation.

The Archive Search Report (ASR), completed in 2003, identified three CWM locations for further evaluation. These are the 1918 West Cantonment Trench System, the Baker Beach Gas Chamber and the Building 672 Gas Chamber. Chemical warfare related training apparently occurred at the 1918 West Cantonment Trench System as evidenced by the discovery of the four CAIS mustard bottles in 2002. This site is shown on Figure 1. The Baker Beach Gas Chamber falls within what is referred to in this work plan as the "Baker Beach Study Area." The Building 672 Gas Chamber falls within the "Cavalry Stables Study Area" and this area, as well as that associated with the Baker Beach Gas Chamber, is also shown on Figure 1.

Additional consideration of CWM related activities, conducted since completion of the ASR, suggests a number of additional buildings and possible training areas for further evaluation. Before listing these it should be emphasized that the Presidio has a long history and that most buildings and open spaces have had multiple uses as mission requirements changed over time. In addition, the Presidio has implemented at least two comprehensive building renumbering schemes, first in the 1930s and again in the 1940s. Obviously as a result of these changes an individual building's use, designation, and number vary over time. In this work plan each study site is referred to by the most common CWM related use that is known and by the last known individual building number if applicable. This is not to imply that these buildings or locations have been used exclusively for CWM related activities. In addition some of the buildings have been demolished, either because they were originally temporary in nature or due to periodic redevelopment and other Presidio improvements.

Additional sites identified for further evaluation are as follows:

In the Baker Beach study area:

- Battery Chamberlin Gas Chamber
- Baker Beach training area

In the Cavalry Stables study area:

- CWS (Chemical Warfare Service) Storeroom, Building 670
- "Chemical Corps", Building 667
- "Chemical Warfare", Building 681
- Cavalry Stables training area

In the Main Post study area:

- CWS Warehouse, Building 94
- CWS Office, Building 219
- "CWS Emerg/Office", Building 222

Some of these locations are known only from references found on Presidio maps. These locations include "Chemical Corps" at Building 667, "Chemical Warfare" at Building 681 and "CWS Emerg/Office" at Building 222. The exact nature of the CWM related activities at these locations is not known and can only be inferred from a general understanding of events occurring at the Presidio during the period when chemical agents were potentially used during training (the 1920s through the 1950s).

The following table summarizes all sites of interest (those originally designated in the ASR for further study and those added after additional evaluation):

Table 1. Chemical Warfare Material Sites

Name	Most Recent Bldg #	CWM Related Use	Earlier Bldg #'s
1918 West Cantonment Trench System	Not applicable	Training	Not applicable
Baker Beach Gas Chamber	Not applicable	Training	Not applicable
Battery Chamberlin Gas Chamber	Bldg 1621	Training	None
Baker Beach Training Area	Not applicable	Training	Not applicable
Bldg 672 Gas Chamber	Bldg 672	Training	None
CWS Storeroom	Bldg 670	Storage	Bldg 141 and 174
"Chemical Corps"	Bldg 667	? Training/Storage	Bldg 62 and 164
"Chem Warfare"	Bldg 681	? Training/Storage	Bldg 26 and 83
Cavalry Stables Training Area	Not applicable	Training	Not applicable
CWS Warehouse	Bldg 94	Storage	Bldg 25 and 151
CWS Office	Bldg 219	Office	Bldg 42 and 181
CWS Emerg/Office	Bldg 222	Storage	Bldg 198 and 187

At the 1918 West Cantonment Trench System the work will involve selective removal of vegetation, raking forest duff out of trenches, foxholes, etc (hereinafter "trenches"), check for CAIS material, excavations of latrine pits, and soil sampling for chemical agent break-down product analysis. At the other locations the work will involve checking the area for evidence of CAIS material and sometimes, as described below, surface wipe or soil sampling for CWM analysis.

c. Work Plan Organization

The organizational structure of this work plan is based on the Type I Work Plan outline, Number MR-001 developed by the U.S. Army Engineering and Support Center, Ordnance and Explosives Directorate in Huntsville Alabama. This work plan outline contains eleven chapters, not all of which are applicable to this project. Those chapters not used are shown below in *italics*:

Chapter 1. Introduction
Chapter 2. Technical Management Plan
Chapter 3. Field Investigation Plan
Chapter 4. Quality Control Plan
Chapter 5. Explosives Management Plan – not used
Chapter 6. Explosives Siting Plan – not used
Chapter 7. Environmental Protection Plan
Chapter 8. Property Management Plan – not used
Chapter 9. Interim Holding Facility Siting Plan for RCWM Projects – not used
Chapter 10. Physical Security Plan for RCWM Project Sites – not used
Chapter 11. References

Specific sections within some chapters are also not applicable to this project and will be so noted in the work plan. Chapter 1 provides an introduction and scope of the project. Management aspects of the project are detailed in Chapter 2, while the detailed project planning and Data Quality Objective (DQO) development is presented in Chapter 3. The Quality Control Plan is found in Chapter 4 and the Environmental Protection Plan at Chapter 7. References are listed in Chapter 11.

d. Project Location

The project is located at the former Presidio of San Francisco, within the City of San Francisco, at the northern tip of the San Francisco Peninsula. The Presidio is approximately 1,416 acres in size. The sites to be addressed during this work are distributed across the Presidio as shown on Figure 1.

e. Site Description

Meteorological Conditions. The Pacific Ocean and San Francisco Bay have a strong influence on the climate of the Presidio. The temperature is moderate; rain and mild temperatures characterize the winter months, and spring is usually sunny and mild. Fog

often occurs in summer when warm, moist air is cooled by cold ocean water along the coast. The average annual rainfall is 19.5 inches. Ninety percent of the rainfall in the San Francisco area occurs from November to April (USAEC, 1997).

Topography. Elevations at the Presidio range from sea level along the northern and western boundaries to approximately 400 feet above seal level. The topographic high point is located adjacent to the Presidio Golf Course in the south-central portion of the Presidio. The northern area along San Francisco Bay is flat low-lying area developed on fill material. Before filling operations of the early 1900s, much of this area consisted of interior marshlands with a sand spit. In contrast, the western boundary along the Pacific Ocean is very steep with slopes of about 50 percent. Baker Beach, at the base of these steep slopes, is a relatively narrow strip of land. The interior portions of the Presidio, including the eastern and southern boundaries, are characterized by gently rolling to hilly topography. Slopes in the western half of the Presidio are typically about 20 percent. Slopes in the eastern half, where most buildings are located, are typically about five percent (USAEC, 1997).

Geology. Unconsolidated deposits of sand, silt, and clay cover much of the Presidio. These unconsolidated deposits overlie the geologically complex Franciscan Formation, an assemblage of mafic volcanic rocks, metamorphic rocks, graywacke sandstone, shale, and siltstone. The geology reflects the Presidio's location between two major fault systems, the San Andreas and Hayward/Rodgers Creek. Artificial fill deposits are present at numerous locations, particularly along the San Francisco Bay. Dune sand forms the surficial deposits throughout most of the southwestern and central Presidio. Beach deposits and artificial fill form the surficial deposits along San Francisco Bay and at Baker Beach along the Pacific Ocean. Beach deposits consist of well-sorted, medium- to coarse-grained sand with some gravel (USAEC, 1997).

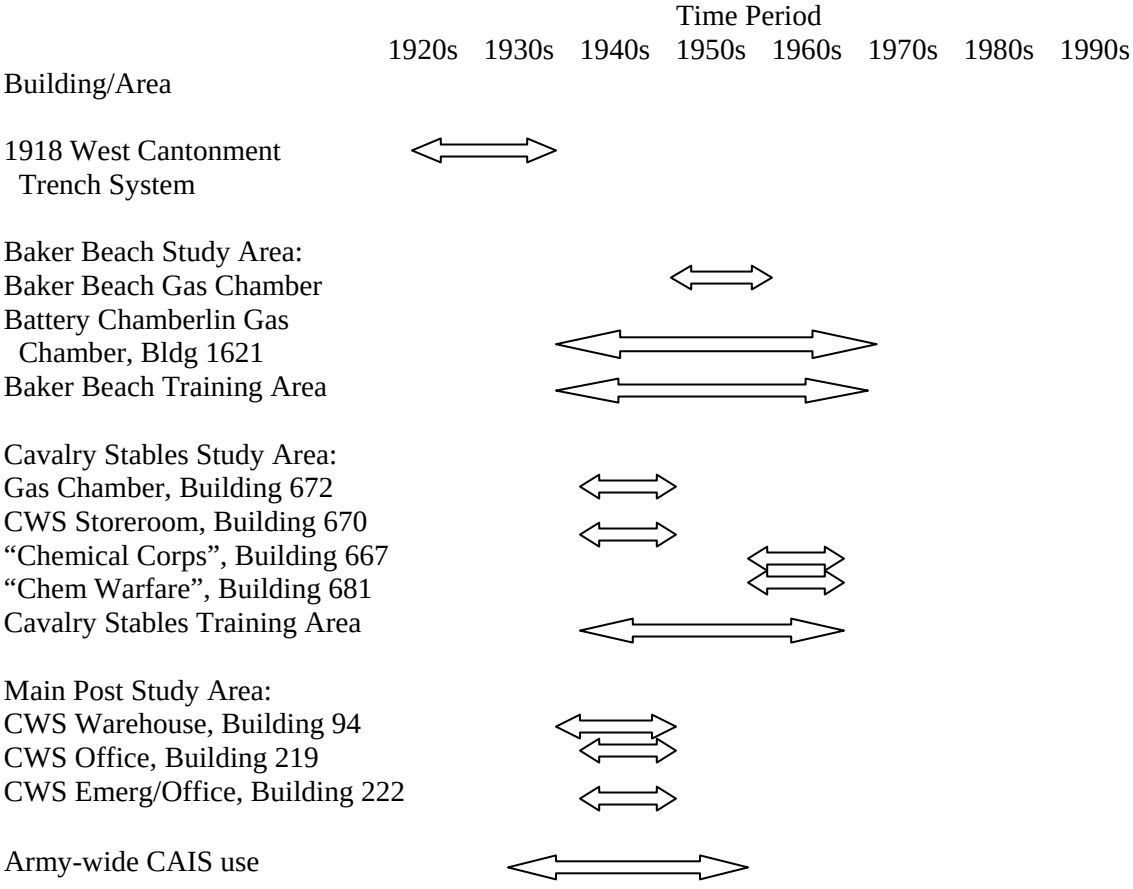
Vegetation. Much of the vegetation seen today at the Presidio results from years of planting by the Army in a program that began in the 1880s. These plantings provided both windbreaks and scenic beauty. Vegetation is dense in the south-central area of the Presidio and locally in many other parts of the former post. A golf course lies along the southwestern part of the Presidio (USAEC, 1997). Isolated enclaves of endangered plants, such as Presidio Clarkia and San Francisco lessingia, are found at the Presidio.

f. Site History

The Presidio was established in 1776 as a military garrison by the government of Spain, which it held until the formation of the Mexican Republic in 1822. The Presidio was formally ceded to the United States from Mexico in 1848. The Presidio has served as a mobilization and embarkation point during several overseas conflicts, a medical debarkation center, and provided coastal defense for the San Francisco Bay area. Prior to transfer of the property to the Department of the Interior and Presidio Trust, the Presidio was a multi-mission installation with various military activities conducted under separate commanders stationed as tenants or satellites (USAEC, 1997; USACE, 2003).

General notes on chemical warfare training. Chemical warfare training in the United States began with the mobilization during World War I (approximately 1917). Troops were trained to protect themselves from exposure to the chemical agents used at that time (such as chlorine, phosgene, and mustard). Training included familiarization with the equipment, test fitting of the gas mask, decontamination training, and tactical exercises in which simulated or training chemical agents were employed. Chemical Warfare Materials were stored at the Presidio and this included statically used munitions filled with smoke, riot control agents and simulants, in addition to CAIS material and bulk mustard agent (the bulk mustard container was apparently used in the 1920s). Dynamically used munitions, such as rifle grenades and hand grenades, which could be filled with riot control agents and simulants, were also present in military unit inventories. Chemical warfare items included candles, capsules, grenades, pots, bombs, smoke generators and land mines. Some of these items would were stored for use in the event of combat deployment while other items were used for routine training. CAIS sets were used from the early 1930s to the late 1950s. Estimated periods of use for the sites considered in this work plan are shown in Table 2. The term "gas chamber" refers to a

Table 2. Estimated Chemical Warfare Training Period of Use



small room in which simulants or riot control agents are used to create conditions in which to test the fit of gas masks as well as to instill confidence that the masks are protective.

General notes on Chemical Warfare Material terminology. Confusion may arise from the term "Chemical Warfare Material" (CWM), as current practices define CWM differently than the U.S. Army did in the first part of the twentieth Century. This work plan utilizes the definition as currently put forth by the U.S. Army Corps of Engineers Safety Office which states: "CWM is an item configured as a munition containing a chemical substance that is intended to kill, seriously injure or incapacitate a person through physiological effects". These items include V-and G-series nerve agent, H-series blister agent (mustard) and lewisite (abbreviated "L") in other than munitions configurations. Due to their prevalence and military unique application, Chemical Agent Identification Sets (CAIS) are also considered CWM. Some CAIS sets (K941 and K942) contained only mustard (H, HD), while others (sets M1, K951, K952, K953, K954) included a combination of mustard (H, HD), lewisite (L), phosgene (CG), and chloropicrin (PS). The current definition of CWM does not include: riot control agents, chemical herbicides, smoke and flame producing items, or soil, water, debris or other media contaminated with chemical agent.

In October 2002 Presidio Trust volunteers found four glass bottles from a K941 CAIS set. The U.S. Army 20th Support Command (formerly the Technical Escort Unit (TEU)) properly removed the bottles, however concerns remained regarding soil and organic forest material, or "duff," that was stockpiled or placed in two roll-off bins. Personnel from the U.S. Army Engineering and Support Center performed a geophysical check of an area centered on the trench and approximately 50' by 100' as a part of the removal of the bottles. No metal objects were found. The area of the discovery was fenced to prevent access by the public (still in place as of the date of this work plan). In 2003, Innovative Technical Solutions, Inc. (ITSI), under the direction of the Corps of Engineers, Sacramento District, prepared a work plan to check the soil and leaves for the presence of additional CAIS materials (ITSI, 2003b). The work plan included a Probability Assessment (USACE, 2003b) that addressed the possibility of finding additional CAIS material in the stockpiles or roll-off bins. The assessment concluded that the probability of encountering additional CAIS material was "remote" (for the bottles) or "improbable" (for the Pig or canisters). The Health and Safety Plan included the contingency to stop all work and secure the area in the event that additional CAIS material was discovered. The on-site Corps of Engineer Ordnance and Explosives (OE) Specialist would make an initial preliminary assessment as to the possible presence of Chemical Warfare Material. This would be followed, as required by Army Regulation 50-6, for either Explosive Ordnance Disposal (EOD) or the 20th Support Command to make a preliminary assessment, with the 20th Support Command making the detailed assessment on discovery of unknown filler (which requires testing to determine if it is Recovered Chemical Warfare Material (RCWM)). The soil and leaves were investigated in October 2003 using procedures documented in the work plan (ITSI, 2003b). Approximately 137 cubic yards of material were investigated and no CAIS materials were found. The Army contractor placed the soil in roll-off bins that were later removed

by the Presidio Trust. The field activities and results were documented in a report (ITSI, 2003a).

The twelve individual sites that are the subject of this work plan (Table 1) are located in four general areas of the Presidio. This is shown in Table 3.

The 1918 West Cantonment Trench System (Figure 2). This area was used for tactical training (assumed to be at the platoon and squad level) from World War I to the 1930s. Evidence for this comes from aerial photos (overhead and oblique), showing a network of trenches and individual foxholes. No plans or reports documenting this use, or chemical training activities, have been identified to date. It was along the southern edge of this former training area, near Inspiration Point, that the four CAIS bottles were discovered in 2002. The exact boundaries of this training area are unknown, but it appears to lie along two parallel ridges to the south of the Main Post, in the south central area of the Presidio. The backstop for a small arms firing range (identified in the ASR as the West Cantonment/Barnard Avenue Protected Range) was located in the valley between the two ridges. The highest density of trenches and foxholes were located along or near the crest

Table 3. Site Locations

Name	Most Recent Bldg #	Status	General Area
1918 West Cantonment Trench System	Not applicable	Open area that is partially developed, partially forested	South Central Presidio
Baker Beach Gas Chamber	Not applicable	Building no longer present	West Presidio - Baker Beach
Battery Chamberlin Gas Chamber	Bldg 1621	Present, historical battery	
Baker Beach training area	Not applicable	Open area	
Bldg 672 Gas Chamber	Bldg 672	Building no longer present	North Central Presidio - Cavalry Stables
CWS Storeroom	Bldg 670	Present, not currently in use	
Chemical Corps	Bldg 667	Present, Archive Office	
Chem Warfare	Bldg 681	Present, not currently in use	
Cavalry Stables training area	Not applicable	Open area	
CWS Warehouse	Bldg 94	Building no longer present	North East Presidio - Main Post
CWS Office	Bldg 219	Building no longer present	
CWS Emerg/Office	Bldg 222	Present, not currently in use	

of the ridges. Approximately half of the eastern most ridge has been redeveloped with residential housing and this part of the site will not be included in the investigation. Construction of the walking trail that runs along the crest of the western ridge may overlie the trenches/foxholes in that area. The remaining part of this former training area is forested and contains trails popular with local residents.

Baker Beach Gas Chamber (Figure 3). This name has been given to a small structure that appears in a 1954 site map, however the building is no longer present. The structure is identified on the map as a "gas chamber" and lies very close to a former radar tower and other communication related infrastructure. The building was about 16 by 19 feet in size and was approximately 475 feet Northeast of Battery Chamberlin. No other information is available on this site. This site may have been used as a gas chamber during the 1950s.

Battery Chamberlin Gas Chamber (Figure 3). Beginning after World War I, some of the Presidio coast defense batteries were taken out of service. This made these fortifications and support buildings available for other uses. Battery Chamberlin, located at Baker Beach, remained partially active as a coastal defense battery until just after World War II (National Park Service, 1997). Historical documents indicate that chemical training activities occurred at this location and the ASR suggests that Battery Chamberlin was the primary location for chemical warfare training, particularly after World War II. Two rooms at Battery Chamberlin have markings above the doors indicating that they were used as a, "CS gas chamber" and a "CN gas chamber," respectively. CS (orthochloro-benzylidene malononitrile) and CN (chloroacetophenone) are both riot control agents used in gas chambers for mask fit and mask confidence training. Each room is estimated to be approximately 15 by 30 feet in size.

Baker Beach training area (Figure 3). No specific map references were found for this site, but historical documents suggest that chemical training activities were conducted in open ground in the vicinity of the Baker Beach Gas Chamber and the Battery Chamberlin Gas Chamber. The estimated limits are shown on Figure 3, however the specific location for individual training activities was not found in the historical documents.

Building 672 Gas Chamber (Figure 4). This building appears only on base maps from the 1940s. It may have been a temporary building that was taken down after World War II. The building was approximately 13 by 15 feet in size. This site was apparently used as a gas chamber during World War II.

CWS Storeroom, Building 670 (Figure 4). This building was originally constructed as a chemical storehouse in 1921 (National Park Service, 1997) and was later used as a magazine. The building is not currently in use. Building lists from 1940 show the building used for District Recruiting Officer Storage and in 1942 as "Storeroom Chemical Warfare". The building is single story and approximately 25 by 34 feet in size.

"Chemical Corps", Building 667 (Figure 4). This building was constructed in the 1920s as part of the cavalry stable complex. When no longer needed for their original purpose these large buildings were used for storage and other activities. Building 667 is currently used as the National Park Service Archives Office. Site maps from the 1950s and 1960s label this building as "Chemical Corps". The building may have been used for chemical warfare office, training, storage, or a combination of these activities. The building has two stories and is approximately 55 by 172 feet in size.

"Chem Warfare", Building 681 (Figure 4). This building appears in the early 1900s and was originally part of a Non Commissioned Officer (NCO) Bachelor Quarters complex. This is south of, and adjacent to, the cavalry stable complex. The building has had multiple uses, most recently as a religious center, however it is not currently in use. Site maps from the 1950s and 1960s label this building as "Chem Warfare". Chemical warfare related use of this building may be similar to the Chemical Corps, Building 667, with the most likely use as CWS troop barracks and classroom. The building has two stories and is approximately 22 by 93 feet in size.

Cavalry Stables training area (Figure 4). Additional chemical training activities may have been conducted in open space in the immediate vicinity of the gas chamber. The estimated boundaries of the training area are shown on Figure 4.

CWS Warehouse, Building 94 (Figure 5). This building appears in the early 1900s and building lists from 1935 identify it as a supply company office. Building lists from 1939 and 1940 identify the building as "Chemical Warfare Serv Whse" and "Reg Supply & Ordnance Officer Ch. to CWS Storeroom, Courts Martial Room & School 30th Infantry." The building was demolished by the 1950s and was approximately 56 by 140 feet in size.

CWS Office, Building 219 (Figure 5). This building appears in the early 1900s and building lists from 1935 and 1939 identify it as a "Post Q.M. Office" (QM stands for "Quartermaster," a branch of the Army related to logistical activities). The 1940 building lists identify the building as "Post Q.M. Office Chemical Warfare – officer HQ Air NCA" and "Post Q.M. Office & C.A. Air, C.W.S. Office." The building was demolished by the 1970s and was approximately 50 by 95 feet in size.

CWS Emerg/Office, Building 222 (Figure 5). This building appears on maps from the 1930s and the 1935 and 1939 building lists identify it as a "Paint Shop-Plumbing Shop-Tin Shop" and "Ordnance Office," respectively. The 1939 building list also includes a hand written note adding "Shops; Chem Warfare & (illegible) Office." The 1940 building list identifies the building as "Post Ordnance Shop & Shops C.W. & Engineers Office." The building still exists and is unoccupied. The building is one story and approximately 42 by 88 feet in size.

g. Current and Projected Land Use

Both current and projected land use is to preserve the historical former military installation through a strategy of leasing existing buildings, combined with leasing land

for limited new construction. This strategy is intended to generate sufficient funds for maintenance and upkeep of the former Army post.

h. Previous Investigation of the Site

The Presidio has been thoroughly investigated by the Army, and later by the National Park Service and the Presidio Trust, for the presence of hazardous waste. The Army investigations began in the 1980s and culminated in the *Final Remedial Investigation Report, Presidio Main Installation, Presidio of San Francisco*, prepared by Dames & Moore in January 1997.

CWM related investigations began with the *Installation Assessment of Presidio San Francisco*, prepared by Environmental Science and Engineering, Inc., in 1983. No use of CWM was noted, however a CS gas chamber was identified in Battery Dynamite (Building 1399).

International Technology Corporation (IT) conducted a records review in 1999 that included consideration of Unexploded Ordnance (UXO) and CWM. This was documented in the Project Memorandum titled *Additional Sites of Potential Environmental Concern: In-Depth Historical Research Results* dated February 17, 1999. The results of this records search are consistent with the ASR prepared in 2003.

The 2002 discovery of CAIS bottles prompted the preparation of the ASR by the US Army Corps of Engineers, St. Louis District, in October 2003. This report confirmed that the Army had trained with CWM on post. CWM training included limited quantities of bulk mustard agent and all three types of CAIS (i.e. instructional, detonation, and toxic sets). The chemical warfare training facilities at the Presidio consisted of a number of gas chambers and training areas used over the years, some of which were clearly identified and others, which were not. The ASR did not identify any overt indication of a CWM hazard at the Presidio.

i. Initial Summary of Risk from Munitions and Explosives of Concern (MEC)

No Munitions and Explosives of Concern (MEC) has been found in the investigation areas. OE Safety Specialists will provide “Construction Support” oversight during this investigation. The Probability Assessment for this project is included at Appendix A, while the Unexploded Ordnance (UXO) Work Plan is found at Appendix B.

CHAPTER 2, TECHNICAL MANAGEMENT PLAN

a. Project Objectives

The objective is to collect sufficient information and data at each site to confirm that no CWM is present.

b. Project Organization

Army organization: This project is conducted by the Corps of Engineers under the direction of the BRAC Environmental Coordinator (BEC).

Presidio Trust: The Presidio Trust is represented on this project by their environmental management office.

National Park Service: The National Park Service will be represented by their environmental restoration staff.

Regulatory Agency: The State of California is represented by the Department of Toxic Substances Control, Berkeley Office.

c. Project Personnel

Army personnel:
BEC – Roger Caswell, 510.909.4804

U.S. Army Corps of Engineers, South Pacific Division Range Support Center:
Project Manager – Bruce Handel, 916.557.7906
Technical Team Leader – Brad Call, 916.557.6649
OE Safety Specialist – Tom Knapp, 916.557.7313
Industrial Hygenist – Dave Elskamp, 916.557.7903
Project Chemist – Pam Werhmann, 916.557.6662
Environmental Engineer – Jennifer Payne, 916.557.7521

U.S. Army Engineering and Support Center, Ordnance and Explosives Directorate in Huntsville Alabama:
Military Munitions Center of Expertise – Hank Hubbard, 256.895.1586
CWM Design Center Operations Officer – Wilson Walters, 256.990.1512

Presidio Trust:
Environmental Program Manager – Craig Cooper, 415.561.4259
Environmental Remediation Specialist – Jennifer Yata, 415.561.4272
Presidio Police – 415.561.5656

National Park Service:
Remediation Manager – Brian Ullensvang, 415.561.4439

Department of Toxic Substances Control:
Hazardous Substances Engineer – Robert Boggs, 510.540.3751

d. Project Communication and Reporting

The Corps of Engineers Project Manager will have responsibility to inform the project team regarding project status, changes to the work plan, as well as any CWM or MEC discoveries. This will take the form of personal communication, e-mails and written correspondence. Details regarding notification procedures upon discovery of CWM or MEC are found at Appendix C.

e. Project Deliverables

The deliverable for this project is a report documenting the site investigation activities, data, quality control measures, and conclusions. The report will contain excerpts from the field notebook as well as copies of the laboratory analytical reports.

f. Project Schedule

The project schedule will be provided to all stakeholders under separate cover. This work plan provides the flexibility to conduct the investigation in phases, should this be necessary due to site or funding constraints.

g. Periodic Reporting

The Corps of Engineers Project Manager will provide monthly status updates to the project team during the course of the investigation.

h. Costing and Billing

Not applicable to this project.

i. Project Public Relations Support

The Corps of Engineers, Sacramento District Public Relations Office will provide support, if necessary, for this project.

j. Subcontractor Management

The Corps of Engineers, Sacramento District project team will manage all contractors. Contractors will be used for chemistry analysis, the vegetation removal, and excavation of potholes.

k. Management of Field Operations

The Corps of Engineers, Sacramento District project team will manage the field operations unless CWM or MEC is discovered. Should this occur the investigation will

stop and the appropriate agency will respond and take control of the site as detailed in Appendix B. OE Safety Specialists will be on site during all field activities to provide the "Construction Support" level of oversight.

In the event that there is a CWM or MEC discovery the site will be secured initially by the Army field investigation team until the local law enforcement agency, the Presidio Police, can respond and take control of the site. Access to the item and site will be restricted and non-essential personnel will be denied entry. Additional information on this subject is provided in Appendices B and C.

Chapter 3. Field Investigation Plan

a. Overall Approach to Munitions Response Activities

(1) Site Characterization Goals

The goal is to confirm that neither CAIS materials nor CWM residues are present at the study sites.

(2) Data Quality Objectives

The Data Quality Objective (DQO) process is listed below:

1. State the problem.
2. Identify the decisions.
3. Identify the inputs to the decision.
4. Define the boundaries of the study.
5. Develop decision rules.
6. Specify limits on decision errors.
7. Specify limits on uncertainty.
8. Optimize the design for obtaining data.

The following describes the specific application of the DQO process to this investigation.

(a) Project Rationale and Desired Outcome. CAIS materials and/or CWM residue may be present on the Presidio. If this condition exists, it represents a hazard to residents, workers and visitors. The goal of this investigation is to confirm that neither CAIS materials nor CWM residues are present at the study sites.

(b) Goals and Decisions.

i. For existing buildings that have been renovated. Buildings renovated within the last 20 years will be checked for the presence of CAIS training materials in likely storage locations. No testing for agent breakdown products will be conducted.
ii. For existing buildings that have not been renovated. Determine if CAIS materials are present in likely storage locations. Collect wipe samples from likely storage locations for agent breakdown product analysis.
iii. For former building locations. Determine if CAIS materials are present in exposed soil in the immediately surrounding area. Collect shallow soil samples for agent breakdown product analysis.
iv. For known training areas. Establish the location of trenches, foxholes, and latrines. Determine if CAIS materials are present in these locations buried under vegetation. Determine if CWM residues are present in shallow soils by sampling a subset of the locations. Determine if CAIS materials were abandoned in latrine holes by excavating a subset of the locations, examining the excavated soil for CAIS materials, and collecting soil samples.

v. For possible training areas (no exact location). Visually check for the presence of CAIS materials. Determine if CWM residues are present by collecting shallow soil samples. All soil samples to be analyzed for chemical agent breakdown products.

(c) The Conceptual Site Model. The Conceptual Site Model (CSM) summarizes what is known or can be surmised regarding CWM at the sites. The CSM for this investigation begins with the introduction of CWM related training during World War 1. Such training would have included procedures to decontaminate CWM as well as the use of individual protective measures (donning the gas mask after detecting the characteristic odors). Mustard agent was a common persistent chemical agent in use during World War I, and was therefore a part of these chemical training exercises. Initially the mustard agent was stored in a bulk container prior to the distribution of smaller quantities for a specific training exercise. Later (1930s) the CAIS sets became available and replaced the larger bulk mustard container. The CAIS sets contained mustard (H, HD), lewisite (L), phosgene (CG), and chloropicrin (PS). Both phosgene and chloropicrin are volatile and would not persist if released from their sealed containers. Mustard was the most prevalent persistent agent used during CWM training and the most likely to be identified through investigation sampling. Generally the training would be conducted outdoors, near related chemical training such as the gas chamber, but some distance from other military or civilian activities. In addition, CWM training was also conducted at the 1918 West Cantonment Trench System. The empty vials and bottles from the CAIS sets would normally be collected and properly disposed of or buried after the training to prevent accidental exposure to mustard or other CWM present in the kits. However occasionally the vials or bottles were not properly disposed of as evidenced by the discovery near Inspiration Point in 2002. Large scale chemical training activities would not have taken place at the Presidio, due to the limited space available for training and the high level of other military activities (headquarters, major hospital, coast defense, etc.). The amounts of mustard used in training was small and in most cases would either volatilize over the years, or be completely hydrolyzed by exposure to the weather. However it is possible that some mustard or breakdown products may be present in training area soil or within unrenovated buildings. Most of the remaining mustard, if any, would be present as "breakdown" products due to the time since the potential release (50 to 70 years). Characteristic mustard breakdowns products are 1,4-oxathiane, 1,4-dithiane, and, to a lesser extent, thiodiglycol (Munrow et at., 1999). The CAIS metal shipping container and related packing materials were under the control of the Chemical Warfare Service officer and were supposed to be recycled (sent back to Edgewood Arsenal) or properly disposed of when the training CWM was completely expended, however in some instances the shipping containers may have been abandoned or buried at the training site.

(d) Data Acquisition Strategy. The Sampling and Analysis Plan (SAP) is provided at Appendix D. The components of the strategy are as follows:

i. For existing buildings that have been renovated. Conduct a through walk through with emphasis on possible storage areas. Individuals knowledgeable about CWM

in general, and CAIS sets in particular, will conduct the walk through. Check the entire building for the presence of discarded CAIS materials.

ii. For existing buildings that have not been renovated. Conduct the walk through as for renovated buildings. Supplement this will collection of wipe samples from the floor of likely storage locations. Collect one such wipe sample from each building in this category. Analyze the wipe samples for chemical agent breakdown products as described in the SAP

iii. For former building locations. Check the immediate area to confirm the absence of CAIS materials. Collect a single shallow soil sample directly beneath buildings used for training, storage, or maintenance of chemical warfare related activities. All soil samples to be analyzed for chemical agent breakdown products.

iv. For known training areas (Figure 6). Use aerial photos and visible depressions on the ground to identify trenches, foxholes and latrines. Seek concurrence in these locations from stakeholders. Vegetation may need to be removed or thinned for access or to visually see the ground surface. Once agreement has been reached regarding the trenches, foxholes and latrines, rake out forest duff to confirm the absence of CAIS materials. Next collect one shallow soil sample from every 30,000 square feet of the site containing trenches and foxholes. The samples will be collected from within the trenches or foxholes. Select up to three depressions identified as "latrine holes" for excavation with a backhoe. Conduct the excavation in accordance with the UXO work plan (Appendix B). Check the excavated soil to confirm the absence of CAIS materials. Collect two soil samples from each excavated latrine hole (one from the sidewall and one from the floor of the excavation). All soil samples to be analyzed for chemical agent breakdown products.

v. For possible training areas (no exact location). Use all available information and best professional judgment to best estimate where the training area might have been located. Visually check the area to confirm the absence of CAIS materials. Then collect at least one shallow soil sample in each possible training area (or one for every 60,000 square feet of area). All soil samples to be analyzed for chemical agent breakdown products.

A summary of the data acquisition strategy is shown on Table 4 on the following page.

(e) Acceptable Level of Uncertainty. Visual surface checks for CAIS materials will be considered adequate if all known trenches, foxholes and latrines are raked to remove duff. Visual surface checks within buildings will be considered adequate if access is available and knowledgeable team members conduct the search. The absence of CWM residues in soil or from surface wipes shall be considered confirmed if the samples are collected as described in this work plan and the analytical quality control measures (defined in Appendix D) are deemed acceptable by the project chemist.

(f) Related Field Tasks.

Field Personnel. The field work will be accomplished by Corps of Engineers and contractor personnel.

Table 4. Summary of Data Acquisition Strategy

Location	Status	Visual Check	Soil Sample	Wipe Sample	Pothole
1918 West Cantonment Trench System	known training area	Rake and check	12	none	3
Baker Beach Gas Chamber	former location	check	1	none	none
Battery Chamberlin Gas Chamber	present	check	none	2	none
Baker Beach Training Area	possible training area	check	2	none	none
Bldg 672 Gas Chamber	former location	check	1	none	none
CWS Storeroom, Bldg 670	former location	check	none	1	none
Chemical Corps, Bldg 667	renovated	check	none	none	none
Chem Warfare, Bldg 681	present	check	none	1	none
Cavalry Stables training area	possible training area	check	2	none	none
CWS Warehouse, Bldg 94	former location	check	1	none	none
CWS Office, Bldg 219	former location	check	1	none	none
CWS Emerg/Office, Bldg 222	present	check	none	1	none

Health and Safety. All work will be conducted in accordance with the Site Safety and Health Plan (see Appendix E). The Site Safety and Health Plan will address sample collection, vegetation removal, physical, insect, poison oak, and other hazards.

Digging Permits. Prior to conducting any excavations in the 1918 West Cantonment Trench System, digging permits will be obtained from the Presidio Trust, the National Park Service or other organizations.

Vegetation Removal. Vegetation removal will be necessary in the 1918 West Cantonment Trench System. The purpose of the removal is to provide visibility to allow identification of trenches and also to provide access to the trenches for duff raking. No more vegetation will be removed than is necessary. The Presidio Trust has notified the Army that vegetation removal cannot occur between March 1 and August 15, due to bird nesting season. In addition, the Presidio Trust has confirmed that there are no wetlands or endangered species within the 1918 West Cantonment Trench System study area. Figure 7 shows the plan for initial vegetation removal. Presidio Trust biologists will be invited to observe the vegetation removal activities.

Vegetation removal will be accomplished using small power tools such as chainsaws, weed-wackers, and similar field portable equipment. Only equipment accepted by the OE Safety Specialists will be used for vegetation removal. This will be supplemented with hand tools such as shears and handsaws. The vegetation will initially be cut to a height of no lower than six inches. OE Safety Specialists will be on hand to examine any potential MEC or CWM item discovered during vegetation removal. Once trenches have been identified additional vegetation will be removed to the ground surface, if necessary, to allow unimpeded duff raking from within the trenches. The vegetation will be moved to the stockpile location with a combination of wheelbarrows, small tractors, and all-terrain vehicles equipped with trailers.

The vegetation removed from the site will initially be stockpiled near Pops Field or the southern end of Quarry Road (possible locations are shown on Figure 7). The stockpile location(s) will be coordinated with the Presidio Trust to avoid inconveniencing the public or local residents, as well as to prevent damage to infrastructure or vegetation. The Presidio Trust mulching facility, if available, will be used to recycle cut vegetation. If the on-site mulching facility is not available then the vegetation will either; 1) be mulched at the stockpile location and shipped off site, 2) be hauled offsite to a recycler or 3) be hauled to a disposal facility. Hauling will be accomplished with either a small truck, a small dump truck, or with a trailer. Presidio Trust trails and roads, and stockpile locations, will be returned to their original condition after the conclusion of vegetation removal activities.

Site Control. Temporary barricades will be installed during the work in the 1918 West Cantonment Trench System to prevent those using hiking trails from exposure to physical hazards such as vegetation clearing and potholing. The barricades will direct hikers to detour around the site. Open excavations will be covered with plywood or other material when not under the direct control of the field team.

(3) Data Incorporated into SI, RI/FS, EE/CA Reports. Not Applicable to this Project

(4) MEC Exposure Analysis. Not Applicable to this Project

(5) Use of Time Critical Removal Actions During the Munitions Response project. Not Applicable to this Project

(6) Follow-on Activities. Not Applicable to this Project

b. Identification of Areas of Concern

The study areas were selected based on evaluation of information provided in the ASR.

c. Geophysical Prove Out Plan and Report, including Contracting Officer Approval Letter.

Not Applicable to this Project

d. Geophysical Investigation Plan

Not Applicable to this Project

e. Geospatial Information and Electronic Submittals

Not Applicable to this Project

f. Intrusive Investigation

Up to three excavations will be conducted within the 1918 West Cantonment Trench System at suspected field latrine locations. These excavations will be performed using a backhoe. OE Safety Specialists will oversee the latrine excavations using the procedures set forth in Appendix B.

g. Investigation Derived Waste Plan

Investigation Derived Waste (IDW) generated during this investigation will be minimal and consists of disposable sample collection equipment. In addition non hazardous waste shall be generated. All of this waste will be properly disposed of in municipal trash receptacles.

h. Risk Characterization and Analysis

Not Applicable to this Project

i. Discussion on the Analysis of Institutional Controls

Not Applicable to this Project

j. Discussion on the preparation of the Recurring Review Plan

Not Applicable to this Project

Chapter 4. Quality Control Plan

a. Chemistry

The chemistry Sampling and Analysis Plan (SAP) is found at Appendix D.

b. CAIS Material Visual Checks

Training areas and building locations will be visually checked for the presence of CAIS materials.

In the 1918 West Cantonment Trench System, a multi-phase process will be used to ensure that all trenches have been evaluated. The process begins with the selective removal of vegetation to allow for the identification of the training positions (trenches and foxholes). The Army will physically mark all training positions using survey stakes and brightly colored tape. Concurrence will be sought with all stakeholders regarding the selection of the positions. Once this has been achieved the next step will be to remove vegetation from the training positions to allow for raking-out and checking of the forest duff. To ensure completeness of the raking process the field team leader will check 100% of the training positions. This check will be documented in the field notebook.

All other locations will be visually checked for CAIS materials prior to sample collection activities. This check will be documented in the field notebook.

c. Survey Data

Survey control will be established in the 1918 West Cantonment Trench System to allow for identification of trenches, foxholes and latrine pits, and documentation of the investigation. The horizontal and vertical accuracy of the survey will be no less than +/- 1.0 feet, as checked using appropriate quality control procedures. The survey reference will be North American Datum, 1927, State Plane Zone III (feet).

Chapter 5. Explosives Management Plan

Not Applicable to this Project

Chapter 6. Explosives Siting Plan

Not Applicable to this Project

Chapter 7. Environmental Protection Plan

a. Sensitive receptors and resources

The Presidio Trust has confirmed that while endangered species and wetlands do exist at the Presidio, they are not located within the 1918 West Cantonment Trench System study area or the Baker Beach study area. Presidio Trust biologists will be invited to observe all phases of the work to ensure that no endangered species are inadvertently disturbed. As discussed in Section 4, vegetation will be removed within the 1918 West Cantonment Trench System study area to provide access and a clear view of the ground. Figure 7 shows the proposed initial vegetation removal.

b. Mitigation Measures

All engine-powered equipment that is to be used shall be checked for leaks. Leaking equipment will not be used until repaired or replaced. Equipment and sorbent materials shall be on hand to collect any spills as soon as they occur. Plastic fencing or survey tape will be used to identify vegetation or areas not to be disturbed during the field activities. Every effort will be made to minimize disturbance to the study sites. The limited potholing will occur in areas with moist soil, so no dust generation is anticipated. However should this become an issue, water spray will be used to minimize dust generation. Equipment will be stored in areas selected to avoid unnecessary damage to vegetation and to minimize inconvenience to local residents.

c. Post investigation clean-up activities

All cut vegetation will be removed from the site or used as per direction from the Presidio Trust. Forest duff raked-out of the trenches will be spread out at the original location and will not be removed from the site. Trash and other debris generated during the investigation will be collected on a daily basis and properly disposed. Investigation equipment will be promptly removed from the Presidio after the conclusion of the field work.

Chapter 8. Property Management Plan

Not Applicable to this Project

Chapter 9. Interim Holding Facility Siting Plan for RCWM Projects

Not Applicable to this Project

Chapter 10. Physical Security Plan for RCWM Project Sites

Not Applicable to this Project

Chapter 11. References

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USACE, 2000. *Engineer Pamphlet 75-1-2, Subject: Unexploded Ordnance (UXO) Support During Hazardous, Toxic, and Radioactive Waste (HTRW) and Construction Activities*. 20 November.

U.S. Army Environmental Center (USAEC), 1997. *Final Remedial Investigation Report, Presidio Main Installation, Presidio of San Francisco*. Dames & Moore. January.

FIGURES

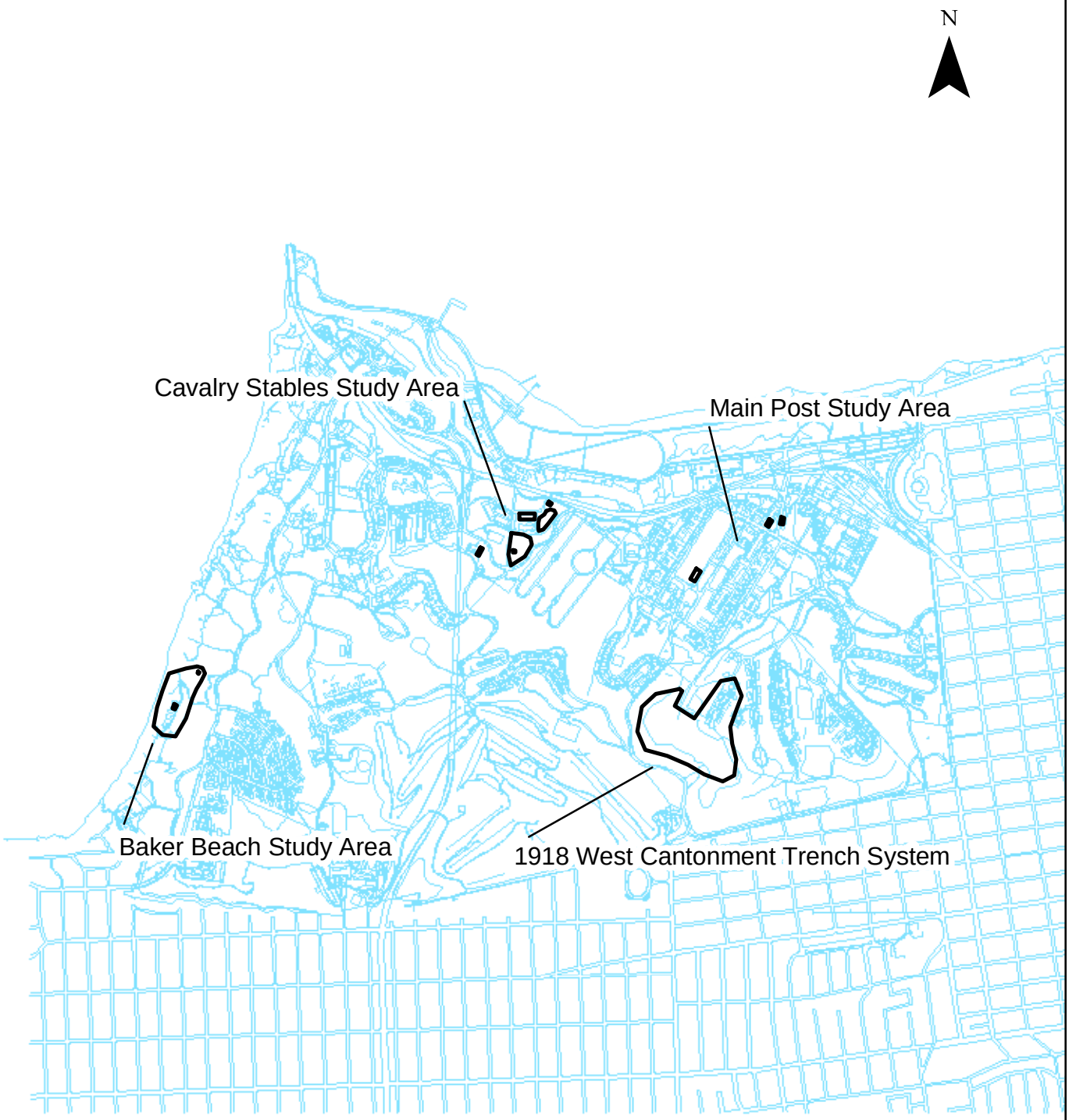


Figure 1
Chemical Warfare Material
Investigation Areas

Presidio of San Francisco
San Francisco, California
March 2006

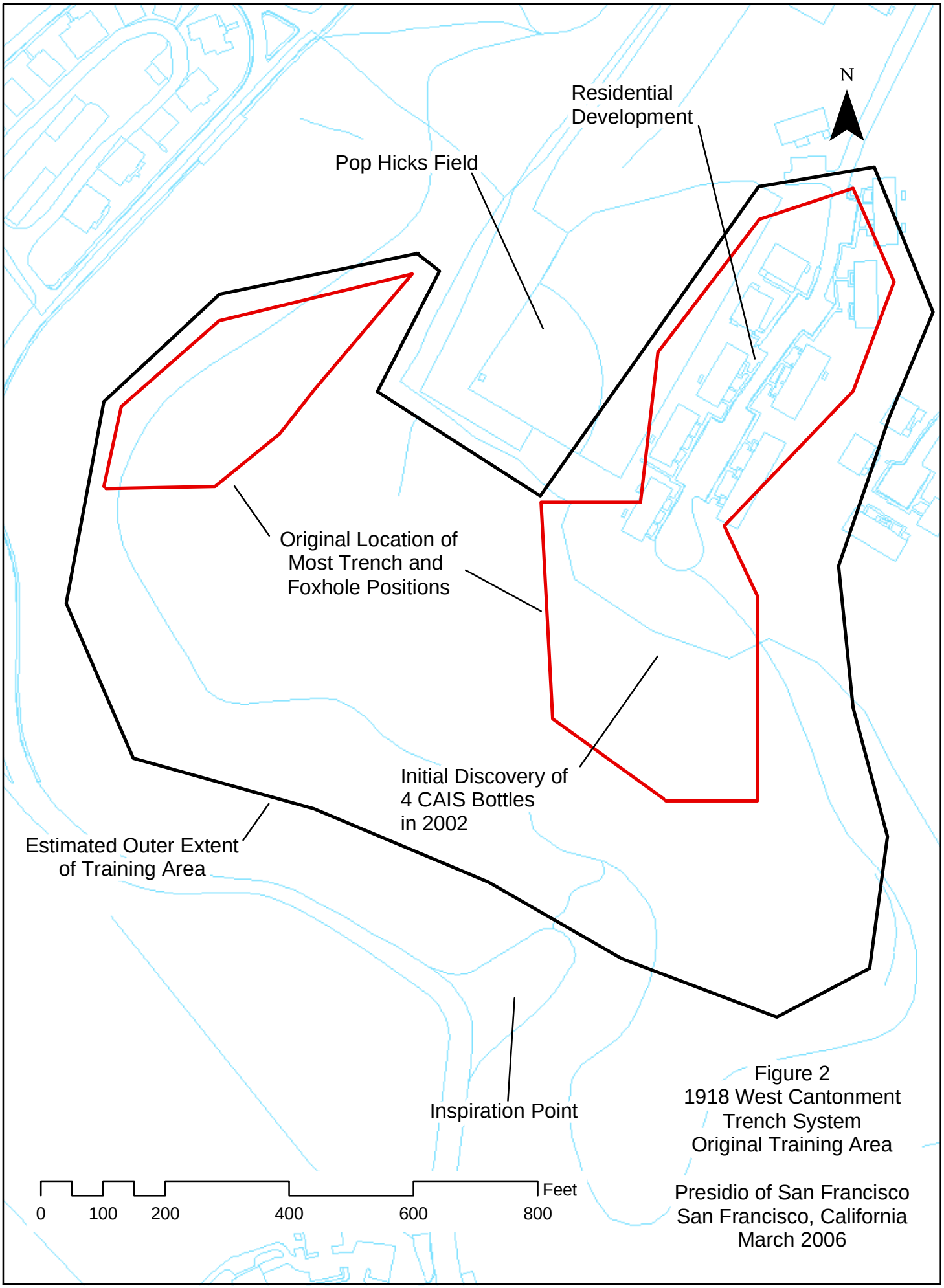


Figure 2
1918 West Cantonment
Trench System
Original Training Area

Presidio of San Francisco
San Francisco, California
March 2006

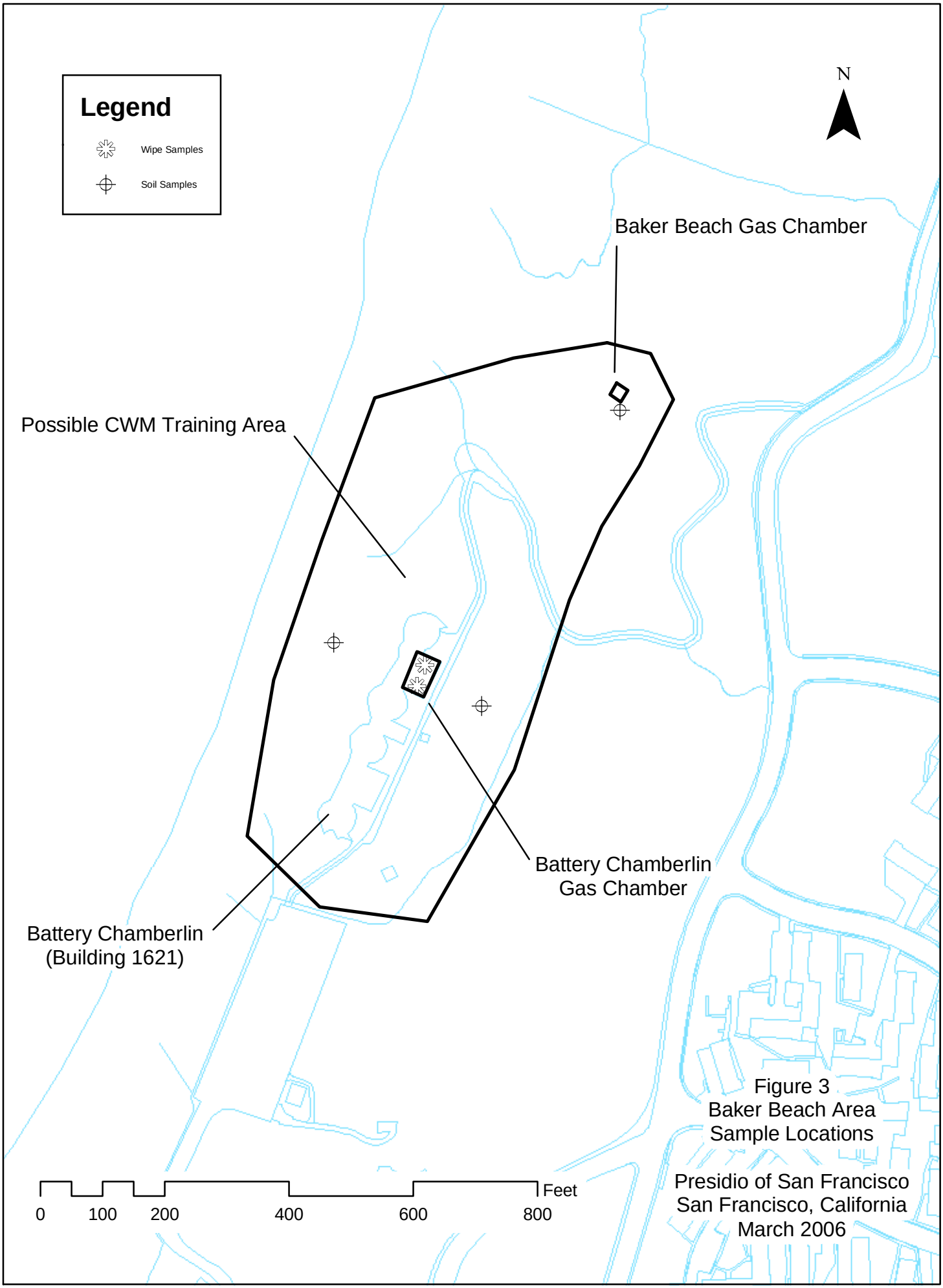


Figure 3
Baker Beach Area
Sample Locations

Presidio of San Francisco
San Francisco, California
March 2006

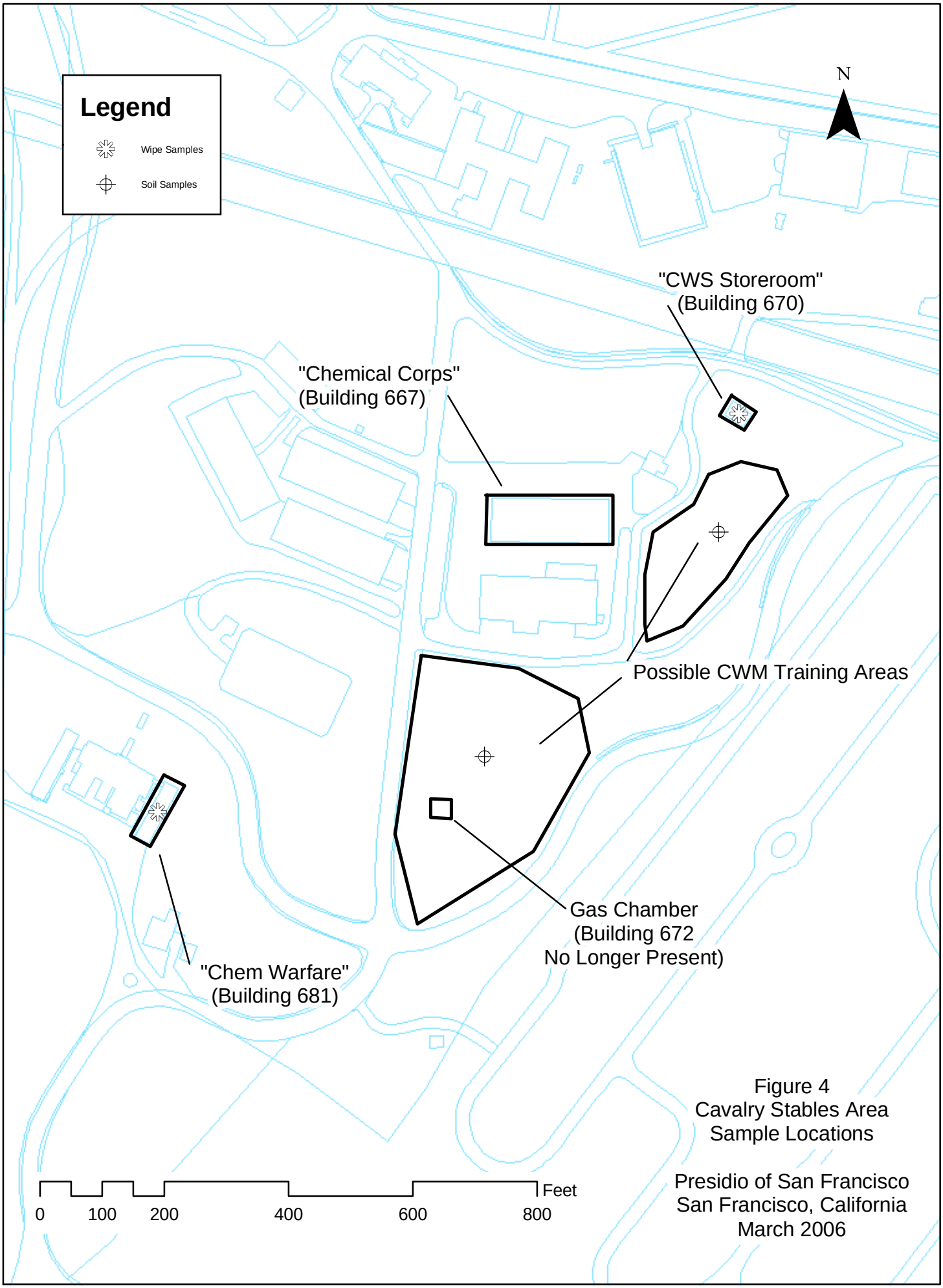


Figure 4
Cavalry Stables Area
Sample Locations

Presidio of San Francisco
San Francisco, California
March 2006

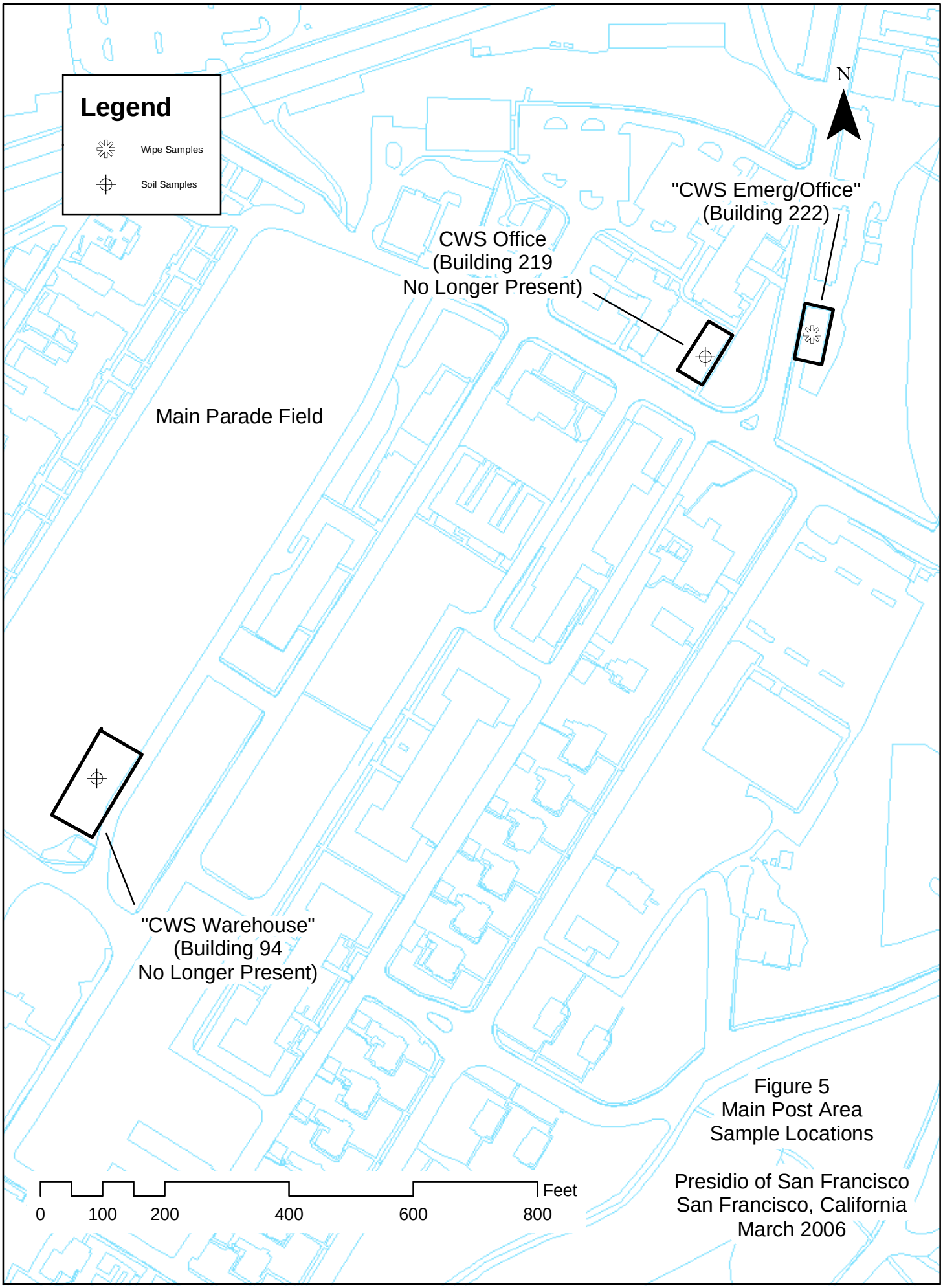


Figure 5
Main Post Area
Sample Locations

Presidio of San Francisco
San Francisco, California
March 2006

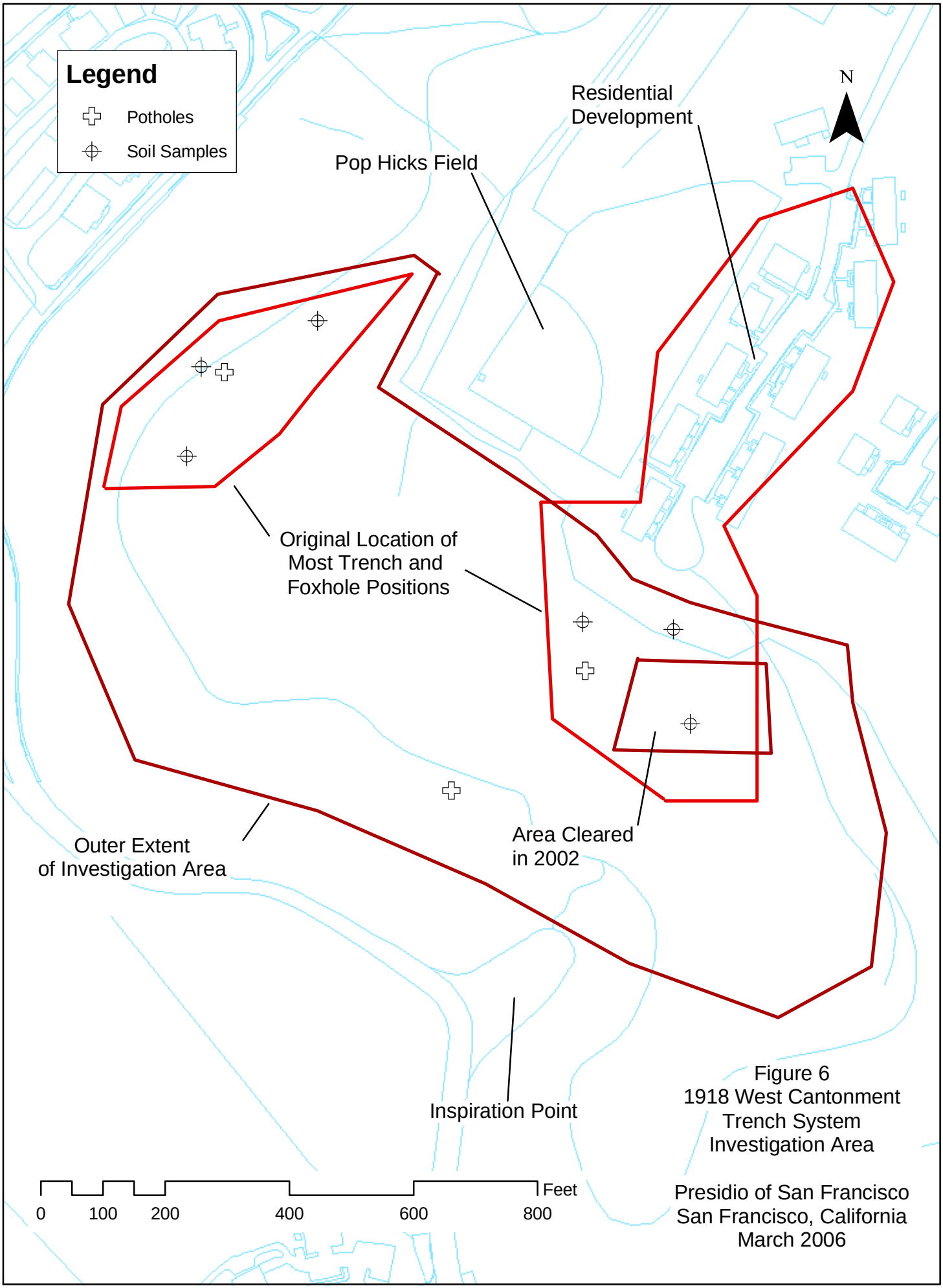


Figure 6
1918 West Cantonment Trench System Investigation Area

Presidio of San Francisco
San Francisco, California
March 2006

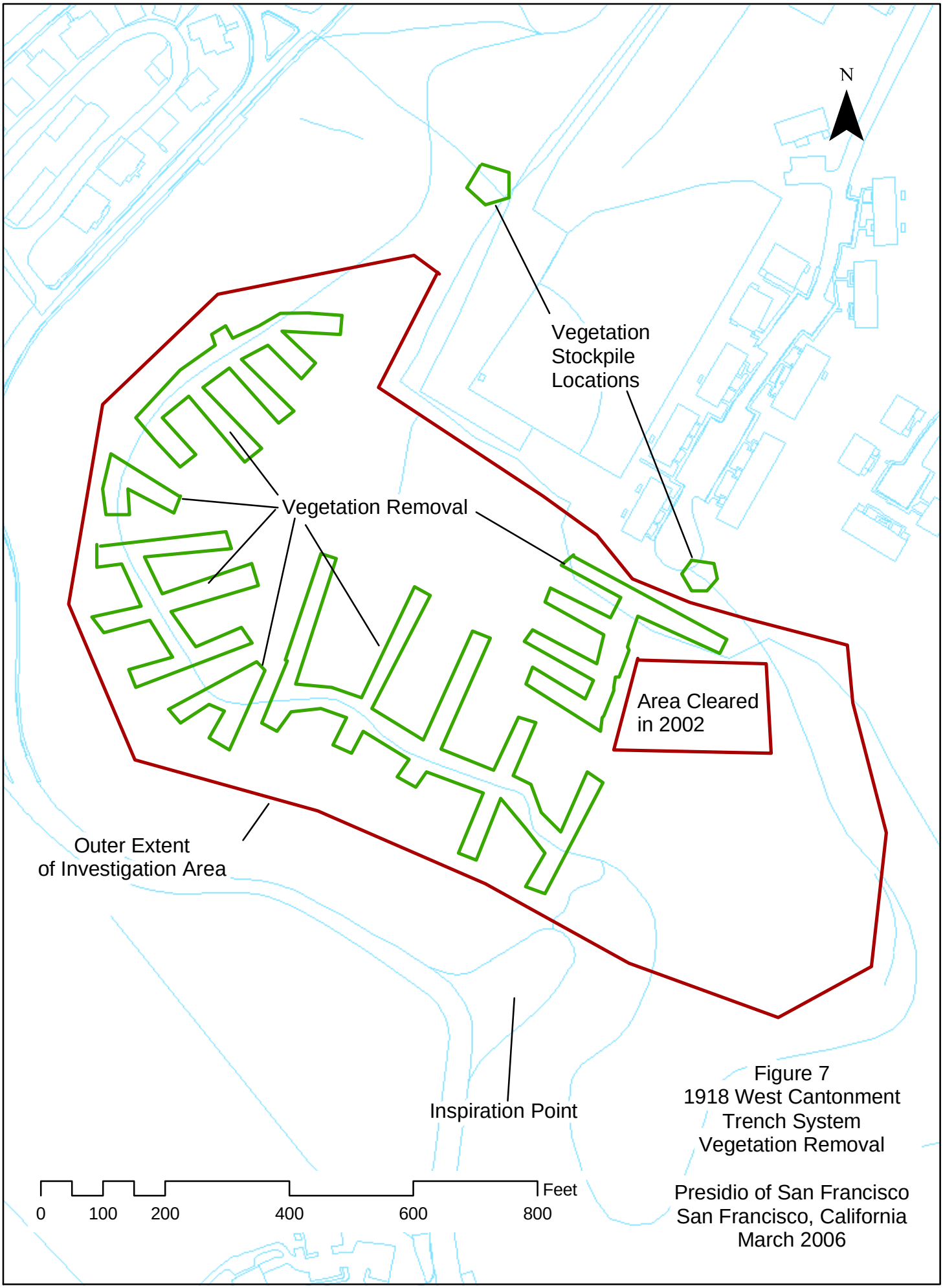


Figure 7
1918 West Cantonment
Trench System
Vegetation Removal

Presidio of San Francisco
San Francisco, California
March 2006

APPENDIX A

Probability Assessment For
The Determination of the Applicability
of the Interim Guidance

1. PROJECT LOCATION: Presidio of San Francisco, San Francisco, CA

2. DATE: 14 November 2005

3. REFERENCES:

a. Memorandum, DASA (I, L&E), subject: Interim Guidance for Biological Warfare Materiel (BWM) and Non-Stockpile Chemical Warfare Materiel (CWM) Response Activities, 5 September 1997.

b. Memorandum, DACS-SF, subject: Applicability of Biological Warfare Material and Non-Stockpile Chemical Warfare Materiel Response Activity Interim Guidance, 19 March 1998.

c. Army Regulation 385-10, subject: Army Safety Program, 29 February 2000

d. Engineer Pamphlet 75-1-2, subject: Munitions and Explosives of Concern (MEC) Support During Hazardous, Toxic, and Radioactive Waste (HTRW) and Construction Activities, 01 August 2004

e. Memorandum, CESPK-DE, subject: Probability Assessment for Inspiration Point, Presidio of San Francisco, CA, 17 March 2003.

f. Archive Search Report, USACE, St. Louis District, subject: Presidio of San Francisco, 6 October 2003

g. Memorandum, CEMP-CE, subject: Interim Guidance-Notification Procedures for Discovery of Recovered Chemical Warfare Materiel (RCWM) During USACE Projects, 23 April 2004

h. Engineer Pamphlet 75-1-3, subject: Recovered Chemical Warfare Materiel (RCWM) Response Process, Nov 2004.

4. BACKGROUND:

a. The Presidio of San Francisco (PSF) consists of 1400 acres on a point at the entrance to San Francisco Bay in San Francisco, CA. The PSF served as a military post for the United States from 1846 until 1995. Thousands of troops camped in tent cities awaiting shipment to the Philippines in 1898. Later, the wounded soldiers returning from the war were treated at Letterman Army General Hospital that was established in 1898. By 1905 twelve coastal defense batteries and accompanying anti-aircraft emplacements were located along the coast of PSF. During WWII PSF became headquarters for the Western Defense Command and in 1946 PSF became the headquarters for the Sixth U.S. Army. PSF, a former Base Realignment and Closure (BRAC) site, is presently managed jointly by the National Park Service and the “Presidio Trust”.

A 1999 Memorandum of Agreement stipulates that the Army retains sole responsibility for remediation of Ordnance and Explosives (OE) and Chemical Warfare Materials (CWM).

b. In early October 2002, volunteer workers at PSF conducting a native plant restoration project within the area of the 1918 West Cantonment Trench System located four vials marked "HS Toxic Gas Set M1". Three vials were unsealed but a fourth had a lid and contained a crystallized black residue. On 22 October a team from the U.S. Army Technical Escort Unit arrived and subsequently removed the vials. Analysis testing confirmed that each bottle contained mustard agent residue. The vials were from a Chemical Agent Identification Sets (CAIS) Toxic Gas Set, M1, K941 typically used in Chemical Warfare detection and decontamination field exercises. Although the vials were removed, concerns remained regarding possibility of additional vials being concealed in the 137-cubic yards of soil and organic forest material (hereinafter "leaves") that had been gathered and stockpiled or gathered and placed in bins.

c. CESPK prepared a work plan to investigate the soil and leaves for the presence of additional CAIS materials. The work plan included a Probability Assessment (reference 3e) relative to finding additional CAIS material in stockpiles/bins. Results of the Probability Assessment are as follows:

ITEM	AR 385-10 (15 Oct. 1979)	AR 385-10 (29 Feb. 2000)
K941 PIG	Improbable	Unlikely
K941 Can	Improbable	Unlikely
K941 Bottle	Remote	Seldom

In October 2003 the remaining soil and leaves were investigated and no CAIS materials were found.

d. An Archives Search Report (ASR), detailing OE and CWM military training activities on the Presidio of San Francisco, was finalized on 6 October 2003 (reference 3f). According to the ASR the only CWM (discounting irritants, smokes, and simulants) utilized for training on PSF were Chemical Agent Identification Sets (CAIS) and one-100 pound container of bulk mustard agent, the bulk agent was never loaded into munitions. All three types of CAIS were used at PST: instructional, detonating, and toxic sets. These sets and the bulk agent were most likely utilized between 1930 and 1950. K941 CAIS contained glass vials of Mustard (H) or Distilled Mustard (HD). K951/K952 CAIS contained Pyrex vials of Mustard (H), Lewisite (L), Chloropicrin (PS), and Phosgene (CG). Within the ASR three sites are listed as possible CWM training sites: 1918 West Cantonment Trench System, Baker Beach Gas Chamber, and Gas Chamber Building 672. CEHNC-OE-CX reviewed the ASR on 18 November 2003 and recommended further investigation of the three sites. The ASR also noted the presence of several other buildings historically appearing to have connection to CWM activities (storage, offices, classrooms or training facilities). However, over time and to accommodate changing missions and activities, the initial purpose of these buildings transitioned to purposes apparently unrelated to CWM activities. The ASR provided no recommendations relative to these historical "CWM" buildings. The CEHNC-CW Design Center did conduct a ranking of the site using the Scoping and Security Study protocols for determining residual risk and hazard assessment. The

CEHNC-CW Design Center concurred with the Probability Assessment for the Determination of Applicability.

5. SCOPE OF PROPOSED SITE ACTIVITIES:

At the request of the Presidio Trust, the U.S. Army Corps of Engineers, Sacramento District proposes to investigate for the presence/non-presence of CAIS vials and/or Agent Breakdown Products (ABP) by conducting investigative activities within the following areas and sites:

a. 1918 West Cantonment Trench System:

(1) Identify the locations of all trenches and foxholes. The general boundaries of the site are known however, prior to field activities, aerial photographs will be studied in an attempt to more closely delineate the exact location of the trenches. Locations of trenches and foxholes will be transposed to the PSF Geographical Information System (GIS) map. Limited brush removal activities, within designated lanes, may be employed to enable visual identification of the trenches and foxholes. Once the trenches are located, hand-rake the leaves from trenches/foxholes then visually inspect the trenches/foxholes for the presence of discarded CAIS vials.

(2) Preparatory to returning the area to its natural state i.e., native plant restoration, the USACE may be requested to confirm/deny the presence of CAIS vials over the entire West Cantonment Trench area versus just the trenches. This effort would involve mechanically mowing or shredding the non-native plant species and then raking and removing the debris along with approximately two to four-inches of detritus organic forest materials. Limited geophysical technology may be employed to assist with the visual surface sweep of the area.

(3) Investigate for presence of discarded CAIS materials/vials in the pre-1950 “latrines”. The exact location of the latrines is unknown however it is known they are near the trenches. Utilizing heavy equipment (backhoe or similar mechanical excavator), excavate to native soil depth and visually inspect the spoils for the presence of CAIS materials. Limited soil sampling of the excavation sidewalls and spoils for ABP may be incorporated for assurance purposes.

b. Baker Beach Gas Chamber: The general location of the facility is known however the exact location is unknown. USACE will visually reconnoiter the area (including Battery Chamberlin and Baker Beach) in an attempt to ascertain the facility’s previous location. Shallow surface soil sampling or wipe sampling may occur within any of the locations to confirm/deny the existence of agent breakdown products or agent-in-soil. *NOTE*: *Agent in soil is not considered CWM but will be identified, handled, and managed IAW 29 CFR 1910.120, 40 CFR 260-279, and/or 40 CFR 300, AR 50-6, and other applicable laws and regulations.* Limited geophysical technology may be employed to assist in locating the gas chamber’s structural footings.

c. Gas Chamber Building 672: The general location of the facility is known however the exact location is unknown. USACE will visually reconnoiter the area in an attempt to ascertain the facility’s previous location. Shallow surface soil sampling may occur to confirm/deny the

existence of agent breakdown products or agent-in-soil. *NOTE: Agent in soil is not considered CWM but will be identified, handled, and managed IAW 29 CFR 1910.120, 40 CFR 260-279, and/or 40 CFR 300, AR 50-6, and other applicable laws and regulations.* Limited geophysical technology may be employed to assist in locating the gas chamber's structural footings.

d. Other buildings and structures with historical CWM association:

(1) Building 670 (post-1943 #174): This structure was originally constructed in 1921 as a "Chemical Warehouse". It has also been titled the "Communication Switch Board Room" but in 1934 was turned over to "other uses". The location of the facility is known. Shallow surface soil sampling may occur to confirm/deny the existence of agent breakdown products or agent-in-soil. *NOTE: Agent in soil is not considered CWM but will be identified, handled, and managed IAW 29 CFR 1910.120, 40 CFR 260-279, and/or 40 CFR 300, AR 50-6, and other applicable laws and regulations.* Limited geophysical technology may be employed to assist in locating the structure's foundation.

(2) Building 94 (earlier bldg, #s: 25 & 151A) was noted on 1939-1940 historical documents as a "CWS (Chemical Warfare Service) Warehouse". By 1942 this building was no longer listed as being used by the CWS. This building has been demolished however the general location of the structure is known (corner of Anza Ave. and Sheridan Ave.) USACE will visually reconnoiter the area in an attempt to ascertain the structure's previous location. Shallow surface soil sampling may occur to confirm/deny the existence of agent breakdown products or agent-in-soil. *NOTE: Agent in soil is not considered CWM but will be identified, handled, and managed IAW 29 CFR 1910.120, 40 CFR 260-279, and/or 40 CFR 300, AR 50-6, and other applicable laws and regulations.* Limited geophysical technology may be employed to assist in locating the structure's foundation.

(3) Building 219 (earlier bldg. #s: 42 & 181) was noted on a May 11 1940 document as "C.W.S Office". By 1942 this building was no longer listed as being used by the CWS. The building has been demolished however the general location (next to the existing fire house) is known. USACE will visually reconnoiter the area in an attempt to ascertain the structures previous location. Shallow surface soil sampling may occur to confirm/deny the existence of agent breakdown products or agent-in-soil. *NOTE: Agent in soil is not considered CWM but will be identified, handled, and managed IAW 29 CFR 1910.120, 40 CFR 260-279, and/or 40 CFR 300, AR 50-6, and other applicable laws and regulations.* Limited geophysical technology may be employed to assist in locating the structure's foundation.

(4) Building 222 (earlier bldg. #s: 187 & 198) was noted in 1942 as being the "CWS Emerg." building. This building was in close proximity to buildings 94 and 219 (mentioned above). This building presently exists and is maintained to historical building standards. USACE will visually reconnoiter the building and surrounding area in an attempt to ascertain the presence or non-presence of CWM or ABP. Shallow surface soil sampling or wipe sampling may occur to confirm/deny the existence of agent breakdown products or agent-in-soil. *NOTE: Agent in soil is not considered CWM but will be identified, handled, and managed IAW 29 CFR 1910.120, 40 CFR 260-279, and/or 40 CFR 300, AR 50-6, and other applicable laws and regulations.*

(5) Building 667 (earlier bldg #s: 62 & 164) and building 681 (earlier bldg #s: 26 & 83) are noted as "Multi Use" buildings. Records from the 1940's indicate the Chemical Warfare Service used the buildings however the specific use remains unknown. These buildings are present today. Because these buildings existed in close proximity to a known gas chamber (building 672) there may have been a CWM relationship. The USACE will visually reconnoiter the buildings and the surrounding areas in an attempt to ascertain the presence or non-presence of CWM or ABP. Shallow surface soil sampling or wipe sampling may occur to confirm/deny the existence of agent breakdown products or agent-in-soil. *NOTE: Agent in soil is not considered CWM but will be identified, handled, and managed IAW 29 CFR 1910.120, 40 CFR 260-279, and/or 40 CFR 300, AR 50-6, and other applicable laws and regulations.*

6. PROBABILITY ASSESSMENT:

The following table summarizes the probability of encountering CWM at each site:

AREA	**PROBABILITY PER AR 385-10 (29 Feb. 2000)**
1918 West Cantonment Trench System	SELDOM. Remotely possible; could occur at some time
Baker Beach Gas Chamber	UNLIKELY. Can assume will not occur, but not impossible
Gas Chamber Building 672	UNLIKELY. Can assume will not occur, but not impossible
Building 670 (Chemical Warehouse)	UNLIKELY. Can assume will not occur, but not impossible
Building 94 (CWS Warehouse)	UNLIKELY. Can assume will not occur, but not impossible
Building 219 (CWS Office)	UNLIKELY. Can assume will not occur, but not impossible
Building 222 (CWS Emergency Bldg.)	UNLIKELY. Can assume will not occur, but not impossible
Building 667 (Multi-use Bldg./CWS connection)	UNLIKELY. Can assume will not occur, but not impossible
Building 681(Multi-use Bldg./CWS connection)	UNLIKELY. Can assume will not occur, but not impossible

a. 1918 West Cantonment Trench System.

(1) According to the Archive Search Report the only CWM (discounting irritants, smokes, and simulants) utilized for training on PSF were Chemical Agent Identification Sets (CAIS) and one-100 pound container of bulk (in a container but not in a munitions) mustard agent. All three types of CAIS were used at PST: instructional, detonating, and toxic sets. These sets and bulk agent were most likely utilized between 1930 and 1950. The ASR site inspection team located no physical evidence of CAIS or containerized agent. The October 2002 incident confirms CAIS were present on PSF however in October 2003, when the remaining soil and leaves were investigated, no other CAIS materials were found.

(2) In concurrence with the ASR, it remains believable, based on area size and configuration, that the 1918 West Cantonment Trench System was a training area for a squad versus a platoon. Historically a squad, based on their size, would be issued a single can

containing 4-vials versus an entire CAIS set containing 12-vials. This thought process effectively limits the issued amount of vials for any given training day.

(3) The ASR's "Textual References" section contains historical documents, including monthly activity and training reports, that identify CWM training of various types (gas mask, gas defense, trench warfare, gas employment and effect, anti-gas instruction, chemical clouds, etc.) occurred from as early as 1918 and continued through 1950. Although not specifically documented (within the ASR), training would also have included the hazards associated with the CAIS. Given troops were CAIS trained, it is unlikely they would discard CAIS vials (in the trench training area) because this act would knowingly be hazardous to their fellow soldiers who would also be trained in the area. Additionally the ASR notes that PSF elements such as the "School of Gas Defense" and "Chemical Warfare School" conducted CWM troop training. The ASR also notes a "Chemical Warfare Officer" was assigned on PSF. These notes suggest knowledgeable staff personnel supervised trench area evolutions hence abandonment (in this area) of CAIS vials would have been prohibited. The ASR also mentions "lack of funding for training" so abandonment of vials would have also been monetarily prohibitive.

(4) The ASR made no mention of the latrines located within the 1918 West Cantonment Trench System area. Historically OE and other items have been discarded in latrines and found years later either accidentally or during the process of environmental restoration. The same principles mentioned above (troop training, supervision of personnel, and cost) would prevent intentional discarding of CAIS material within the latrines, however it remains remotely possible for OE to be discarded within the latrines hence it is recommended excavation of latrines be undertaken utilizing UXO personnel to provide safety support.

(4) Conclusion. Based on the above analysis it is credible the four vials located in 2002 were accidentally left behind on a "one-time" occasion versus vials being intentionally discarded on a routine bases. Additionally, a large part of this area has in the past and continues today to receive thousands of visitors on an annual basis. Visible CAIS vials most certainly would have been discovered and shallow buried CAIS vials would have been stepped on and broken thereby reducing the effective persistency of the agent. It is however remotely possible for CAIS vials to remain below a shallow depth of organic forest material or within the latrines hence (per reference 3c) the probability of CWM encounter on this site is considered to be: **SELDOM, Remotely possible; could occur at some time**.

b. Baker Beach Gas Chamber.

(1) The ASR could not confirm nor deny that CAIS vials were used at this site nor in the area surrounding the site, including Baker Beach and Battery Chamberlin. The ASR site inspection team located no physical evidence of CAIS presence at the probable location of the gas chamber or at Baker Beach and Battery Chamberlin. The USAC, Sacramento District has previously conducted visits over this entire area and located no physical evidence of CAIS presence. The entire area has in the past and continues today to receive thousands of visitors on an annual basis. The area remains void of most vegetation so if by chance a bottle were disposed of it appears likely it would have been discovered.

(2) The ASR did confirm the use of CS and CN within Gas Chamber operations at Battery Chamberlin however these agents do not fall within the CWM realm. Gas chamber operations do not lend themselves to disposal of CAIS vials. Typically chamber activities would be very controlled hence issuance of an agent bottle would be limited by what was actually needed and that amount would be used versus discarded.

(3) Shallow surface sampling may be conducted over the entire area of Baker Beach, Battery Chamberlin and the suspected gas chamber's location. Although there is no evidence of previous use of CAIS materials, sampling personnel will nonetheless be trained to collect samples gently and to halt sampling activities should an obstacle impede the sampling effort. The obstacle will be considered to be a CAIS bottle and will be investigated only to the point that renders a positive identification of the obstacle.

(4) Conclusion. There is no evidence to suggest CAIS materials were used at this site however there is evidence that CAIS materials were utilized on the PSF. The incorporation of protective sampling processes will prevent breakage of a bottle in the unlikely event one is encountered hence the possibility of personal contamination is very greatly minimized. Based on this information and in accordance with reference 3c the probability of CWM encounter is **UNLIKELY. Can assume (agent encounter) will not occur, but not impossible.**

c. Gas Chamber Building 672.

(1) The ASR could not confirm nor deny that CAIS vials were used at or near this site. The ASR site inspection team located no physical evidence of CAIS presence at the probable location of the gas chamber. The USAC, Sacramento District has previously conducted visits to this site and they located no physical evidence of CAIS presence. The entire area has in the past and continues today to receive thousands of visitors on an annual basis. The area remains void of most vegetation so if by chance a bottle were disposed of it appears likely it would have been discovered.

(2) The ASR did confirm the use of CS and CN within Gas Chamber operations however these agents do not fall within the CWM realm. Gas chamber operations do not lend themselves to disposal of CAIS vials. Typically chamber activities would be very controlled hence issuance of an agent bottle would be limited by what was actually needed and that amount would be used versus discarded.

(3) Shallow surface soil sampling to a depth of 12-inches may be conducted in this area. Although there is no evidence of previous use of CAIS materials, sampling personnel will nonetheless be trained to collect samples gently and to halt sampling activities should an obstacle impede the sampling effort. The obstacle will be considered to be a CAIS bottle and will be investigated only to the point that renders a positive identification of the obstacle.

(4) Conclusion. There is no evidence to suggest CAIS materials were used at this site however there is evidence that CAIS materials were utilized on the PSF. The incorporation of protective sampling processes will prevent breakage of a bottle in the unlikely event one is encountered hence the possibility of personal contamination is very greatly minimized. Based on

this information and per reference 3c the probability of CWM encounter is **UNLIKELY. Can assume will not occur, but not impossible.**

d. Other buildings and structures with historical CWM association.

(1) Very limited information is available as to the historical use of these buildings. There is no evidence to suggest CAIS or CWM materials were ever used or stored within these structures but there is also no evidence to the contrary. Throughout the years building numbers changed, buildings were assigned different usages, and buildings were demolished. What is apparent from comparison of historical maps to present day maps is that all of the structures with perceivable CWM association existed within areas that have continuously undergone marked increases of personnel (tourists, PSF workers, contractors). Additionally, and over the past years, rejuvenation and maintenance of historical buildings within these areas has been substantial.

(2) There are two areas that generally encompass the historical CWM structures/locations.

(a) The first area, encompassing buildings 670, 667 and 681, is located in the north-central portion of PSF. Building 667 is presently the Park Archives and Record Center and houses a staff of individuals. Building 681 remains as a historical building and is maintained to historical standards. Building 670 also exists today as a historical structure and is located in close proximity to the Park Archives and Record center.

(b) The second area, encompassing buildings 94, 219 and 222 is located in the northwest portion of PSF generally in the "Main Post" area. The Main Post area presently consists of numerous occupied buildings (National Park Service Visitor Center, bowling center, Presidio Trust offices, Chapel, Post Office), historical buildings, parking lots, and manicured grounds.

(2) Conclusion. Considering both general areas and buildings within those areas are consistently maintained for historical purposes by the Presidio Trust and given the high volume of tourist traffic the two areas generate, it is considered extremely unlikely CAIS materials could possibly remain undiscovered. Certainly the one container of bulk mustard agent could not remain undiscovered. Based on this and per reference 3c the probability of encounter is **UNLIKELY. Can assume (agent encounter) will not occur, but not impossible.** There is a possibility that shallow surface soil sampling will detect the existence of agent breakdown products. Agent in soil is not considered CWM but will be identified, handled, and managed IAW 29 CFR 1910.120, 40 CFR 260-279, and/or 40 CFR 300, AR 50-6, and other applicable laws and regulations.

7. RECOMMENDATIONS:

a. Based on review of listed references and the conclusions above it is recommended proposed site activities proceed as Non-CWM (i.e., the Interim Guidance, reference 3a, will not be implemented).

b. In accordance with reference 3b, the Site Safety and Health Plan for the proposed site activities will include contingency plans providing for a safe and expeditious response in the

event an item of unknown fill is encountered. The plan shall include the requirement for daily safety briefings covering hazards associated with CAIS. If during work activities a suspect CWM item is located, all work will immediately cease, project personnel will withdraw along cleared path upwind from the discovery, and two personnel will secure the site to prevent unauthorized access. An Explosive Ordnance Disposal (EOD) or a 20th Support Command (formerly TEU) response will be requested. The notification procedures for discovery of Recovered Chemical Warfare Materiel shall be in accordance with reference 3g. Once CWM is located work may not resume without reevaluation of the site.

c. The ASR identified the 1918 West Cantonment Trench System as an area that, in addition to CWM activities, could have been a training area for "grenades and possibly other munitions". To date no Munitions or Explosives of Concern (MEC) have been discovered in this area hence, IAW reference 3d, the probability of encounter is considered to be "Low". Therefore it is recommended the proposed activities be conducted utilizing UXO qualified personnel to provide "Safety Support" during construction (hand-raking, mowing, mulching, brush cutting, excavation of latrine) activities.

d. The ASR did not identify the other sites as possible MEC sites however it is considered prudent to provide UXO qualified personnel to provide "Safety Support" during sampling activities within these areas.

A. R. Smith
Chief, Safety and Occupational Health Office

APPENDIX B

Unexploded Ordnance (UXO) Work Plan

APPENDIX B – TABLE OF CONTENTS

1.0 INTRODUCTION

This Unexploded Ordnance (UXO) Work Plan (WP) was prepared by the U.S. Army Corps of Engineers, Sacramento District (CESPK) to describe procedures and protocols to be followed during investigative efforts to determine the presence/non-presence of Chemical Agent Identification Sets (CAIS) vials and/or Agent Breakdown Products (ABP) at the Presidio of San Francisco (PSF), California. The work required under this project involves UXO Safety Support during brush cutting, raking, shallow surface sampling, swipe-sampling and excavation activities.

1.1 Location

The Presidio of San Francisco (PSF) consists of 1400 acres on a point at the entrance to San Francisco Bay in San Francisco, CA. The following areas will be investigated: 1918 West Containment Trench System, Gas Chamber Building 672, Baker Beach Gas Chamber, Storeroom Building 670, Multi-use Buildings 62 and 26, CW/Emergency Building 187, Office Building 181, and Storeroom Building 151A.

1.2 Facility History

The PSF served as a military post for the United States from 1846 until 1995. Thousands of troops camped in tent cities awaiting shipment to the Philippines in 1898. Later, the wounded soldiers returning from the war were treated at Letterman Army General Hospital that was established in 1898. By 1905 twelve coastal defense batteries and accompanying anti-aircraft emplacements were located along the coast of PSF. During WWII PSF became headquarters for the Western Defense Command and in 1946 PSF became the headquarters for the Sixth U.S. Army. The PSF, a former Base Realignment and Closure (BRAC) site, is presently managed jointly by the National Park Service and the "Presidio Trust". A 1999 Memorandum of Agreement stipulates that the Army retains sole responsibility for remediation of Ordnance and Explosives (OE) and Chemical Warfare Materials (CWM).

1.3 Previous Investigations

In early October 2002, volunteer workers at PSF conducting a native plant restoration project within the area of the 1918 West Cantonment Trench System located four vials marked "HS Toxic Gas Set M1". Three vials were unsealed but a fourth had a lid and contained a crystallized black residue. On 22 October a team from the U.S. Army Technical Escort Unit arrived and subsequently removed the vials. Analysis testing confirmed that each bottle contained mustard agent residue. The vials were from a Chemical Agent Identification Sets (CAIS) Toxic Gas Set, M1, K941 typically used in Chemical Warfare detection and decontamination field exercises. Although the vials were removed, concerns remained regarding possibility of additional vials being concealed in the 137-cubic yards of soil and organic forest material that had been gathered and stockpiled or gathered and placed in bins.

CESPK prepared a work plan to investigate the soil and forest material for the presence of additional CAIS materials. The work plan included a Probability Assessment relative to finding additional CAIS material in stockpiles/bins. In October 2003 the remaining soil and leaves were investigated and no CAIS materials were found.

1.4 Topography/Geology

1.4.1 Topography of the Presidio is highly variable with elevations ranging from sea level along the northern and western boundaries to approximately 400 feet above Presidio lower low water (feet LLW). The topographic high point is located adjacent to the Presidio Golf Course in the south central portion of the Presidio.

The northern boundary along San Francisco Bay is a low flat area developed on fill material. In contrast, the western boundary along the Pacific Ocean is very steep with slopes averaging 50 percent. Baker Beach, at the base of these steep slopes, is a relatively narrow strip of land. The interior portions of the Presidio, including the eastern and southern boundaries, are characterized by gently rolling hills. Slopes in the western half of the installation typically average 20 percent. Slopes in the eastern half, where most buildings are located, typically average 5 percent.

1.4.2 For a detailed report on the geologic setting refer to USACE, Presidio of San Francisco, California Draft Basewide Groundwater Monitoring Plan, July 1996.

1.5 Climate

Summertime in San Francisco is characterized by cool marine air and persistent coastal stratus and fog, with average maximum temperatures between 60øF and 70øF, and minima between 50øF and 55øF. The mornings typically find the entire city overcast followed by clearing on the warmer bay side, but only partial clearing on the cooler ocean side. Westerly winds are channeled through the Golden Gate reaching a maximum during the afternoon with speeds between 20 and 30 miles per hour being typical. Rainfall from May through September is relatively rare, with an aggregate of less than an inch, or only about 5 percent of the yearly average total of approximately 21.5 inches.

Winter temperatures in San Francisco are temperate, with highs between 55øF and 60øF and lows in the 45øF to 50øF range (Null, 1978). Wintertime fog is less common than that of summer, but is typically much denser and has a greater impact upon transportation systems due to greatly reduced visibilities. Over 80 percent of San Francisco's seasonal rain falls between November and March, occurring over about 10 days per month. Winter thunderstorms occur on the average only twice per season.

Spring and fall are transition periods for San Francisco. These seasons usually produce the most cloud-free days. San Francisco's hottest days are typically during the spring and fall. The occurrence of rainfall during the early spring and fall is infrequent, with only about 5 days per month on the average. While most storms during these periods produce light precipitation, the occasional storm can produce heavy rainfall events.

2.0 TECHNICAL MANAGEMENT PLAN

2.1 General

2.1.1 UXO support activities shall be conducted in full compliance with United States Army Corps of Engineers (USACE), Department of Army (DA), and Department of Defense

(DoD) requirements regarding personnel, equipment, and procedures. (All UXO operations shall emphasize anomaly avoidance, whenever possible, and be performed in a manner consistent with the Comprehensive Environmental Response, Compensation, and Liability Act [CERCLA] and the National Contingency Plan [NCP]. Therefore, the administrative requirements of Federal, state, or local permits are not required for implementation of any UXO procedures, including on-site destruction of UXO, if required, but the substantive permit requirements must be fulfilled.)

2.1.2 The provisions of 29 CFR 1910.120 shall apply to all UXO-related actions taken at this site. In addition, UXO personnel involved in performing UXO tasks will be limited to a 10-hour workday and a 40-hour workweek. Two consecutive workweeks shall be separated by a minimum of 48 hours of rest.

2.2 Chemical Warfare Material (CWM)

2.2.1 Chemical Warefare materiels have been used on the PSF. The Archive Search Report noted Chemical Identification Sets and bulk agents (One 100 pound container of Mustard agent) as having been present on the PSF. The October 2003 location of CAIS vials confirms that in fact CAIS were trained with on the PSF. Because CWM materials were discovered a CWM Probability Assessment for all areas of the planned investigative work was conducted and the Sacramento District Commander authorized work to proceed as "non-CWM activities". The conclusions of the CWM Probability Assessment are as follows:

AREA	PROBABILITY PER AR 385-10 (29 Feb. 2000)
1918 West Cantonment Trench System	SELDOM. Remotely possible; could occur at some time
Baker Beach Gas Chamber	UNLIKELY. Can assume will not occur, but not impossible
Gas Chamber Building 672	UNLIKELY. Can assume will not occur, but not impossible
Building 670 (Chemical Warehouse)	UNLIKELY. Can assume will not occur, but not impossible
Building 94 (CWS Warehouse)	UNLIKELY. Can assume will not occur, but not impossible
Building 219 (CWS Office)	UNLIKELY. Can assume will not occur, but not impossible
Building 222 (CWS Emergency/Office)	UNLIKELY. Can assume will not occur, but not impossible
Building 667 (Multi-use Bldg.)	UNLIKELY. Can assume will not occur, but not impossible
Building 681 (Multi-use Bldg.)	UNLIKELY. Can assume will not occur, but not impossible

In addition to actual CWM agent, the following items were also known to exist on the PSF: smoke pots, generators, riot control agents (CS, CN), and simulants.

2.2.2 In the event suspect CWM is encountered, all work will immediately cease and project personnel will be evacuated along cleared paths upwind from the discovery. The OE Safety Specialists shall access the need to notify or evacuate any additional areas within proximity of the discovery. A team consisting of a minimum of two USACE personnel shall immediately secure the area to prevent unauthorized access. Personnel should position themselves as far upwind as possible while still maintaining security of the area. USACE personnel will continue to secure the site until relieved by Officers from the Presidio Trust Police Department.

2.2.3 The USACE has been requested to initiate the appropriate response actions in the event Recovered Chemical Warfare Materiel (RCWM) is discovered (at this BRAC site). The OE Safety Specialist will **immediately** initiate response actions and **simultaneously** notify appropriate authorities per the following table:

RCWM REPORTING POINTS OF CONTACT		
POC	**PHONE**	**PURPOSE**
Presidio Trust Police Department	(415) 561-5656	Dept. personnel will provide a security force to prevent unauthorized access to the discovery. They will notify their Law Enforcement Chain of Command
Mr. Wilson Walters (primary POC) CEHNC-OE-CW Mr. Hank Hubbard (secondary POC) CEHNC-OE-CX	(256) 895-1290 (256) 895-1586	Mr. Walters or Mr. Hubbard will contact appropriate response authorities (i.e., EOD or 20th Support Command (Formerly TEU) and within 3-hours notify: Army Operation Center Director of Army Safety HQ USACE and FORSCOMEOC
Mr. A. R. Smith CESPK-SO	(916) 557-6973	District Safety Office will notify District Commander, PAO, and State Local Government/Congressional Authorities. Coordinate w/District Commander for media release.
Mr. Bruce Handel (primary POC) CESPK-PM-M Mr. Brad Call CESPK-ED-GE (secondary POC)	(916) 557-7906 (916) 557-6649	Mr. Handel or Mr. Call will Inform the USACE Project Team
Mr. Roger Caswell BRAC Environmental Coordinator (BEC)	(510) 909-4804	Notify BRAC colleagues
Mr. Craig Cooper Presidio Trust	(415) 561-4259	Presidio responsibilities and colleagues
Mr. Robert Boggs DTSC	(510) 540-3751	Notify DTSC colleagues

The USACE shall also prepare a Chemical Event Report per the guidelines presented in paragraph 3.3 however initial reporting shall be by telephone and shall transmit as much Event Report information as is available.

2.3 UXO/MEC

2.3.1 There have been no reported discoveries of MEC/UXO on these sites however the ASR noted "Training with grenades and possibly other munitions" occurred within the area of the "1918 West Cantonment Trench System". Because there "may" be MEC present at this location, the USACE will, IAW EP 75-1-2, provide MEC standby support during all investigative processes at this site (1918 West Cantonment Trench System). At this site two-USACE OE Safety Specialists will provide the required standby support. Although not required the USACE will provide one-USACE OE Safety Specialist during the conduct of investigative activities at the other sites.

2.3.2 MEC/UXO Identification and Disposition

2.3.2.1 If surface or subsurface MEC is encountered, the USACE Safety Specialists will make every effort to identify the item through visual examination of the item for markings and other identifying features such as shape, size, and external fittings. Items will not be moved during the inspection until the fuze condition can be ascertained. If the condition is questionable, consider the fuze to be armed. The fuze is considered the most hazardous component of a UXO regardless of type or condition.

2.3.2.2 Any MEC/UXO that cannot be positively identified or MEC/UXO that contains energetic material or possible energetic residue requires a disposal response.

2.3.2.3 On the PSF, USACE personnel are not authorized to destroy MEC/UXO. In the event MEC/UXO is encountered that due to fuzing or current condition presents an eminent hazard the USACE has been requested to initiate response actions and notify appropriate authorities. The OE Safety Specialists will initiate response actions and notify appropriate authorities per the following table:

MEC REPORTING POINTS OF CONTACT		
POC	**PHONE**	**PURPOSE**
Presidio Trust Police Department	(415) 561-5656	Dept. personnel will provide a security force to prevent unauthorized access to the discovery. They will notify their Law Enforcement Chain of Command
Mr. Bill Veith CEHNC-OE-CX (primary POC) Mr. Hank Hubbard (secondary POC) CEHNC-OE-CX	(256) 895-1592 (256) 895-1586	Mr. Veith or Mr. Hubbard will contact appropriate EOD response authorities
Mr. A. R. Smith CESPK-SO	(916) 557-6973	District Safety will notify District Commander, PAO (if required)
Mr. Bruce Handel (primary POC) CESPK-PM-M Mr. Brad Call CESPK-ED-GE (secondary POC)	(916) 557-7906 (916) 557-6649	Mr. Handel or Mr. Call will Inform the USACE Project Team
Mr. Roger Caswell BRAC Environmental Coordinator (BEC)	(510) 909-4804	Will notify BRAC colleagues
Mr. Craig Cooper Presidio Trust	(415) 561-4259	Presidio responsibilities and notify colleagues
Mr. Robert Boggs DTSC	(510) 540-3751	Notify DTSC colleagues

While awaiting arrival of Presidio Police personnel, the USACE Team will ensure site security is maintained, ensure access to the item(s) is restricted and ensure non-essential personnel are denied entry. At the request of the responding EOD unit, the USACE Safety Specialists may provide assistance to the response team.

2.4 MEX/UXO Safety Support Plan

2.4.1 Personnel Qualifications.

Two qualified USACE OE Safety Specialists, one being a UXO Technician III, shall provide safety support during investigation and construction activities within the area of the "1918 West Cantonment Trench System". This area is potentially contaminated with CWM/MEC/UXO. Qualifications standards are defined in "DDESB Technical Paper #18". One USACE OE Safety Specialist (UXO Technician III) shall provide safety support at all other sites to be investigated.

2.4.2 Method of Work Accomplishment.

2.4.2.1 The USACE Safety Specialists should physically preview the actual construction footprint with the on-site management of the construction contractor and discuss visual observations and potential areas of concern. In the event MEC/UXO is discovered, the USACE Safety Specialists shall place flagging adjacent to the discovery for subsequent visual reference, select a course around the item, and lead project personnel out of the area.

2.4.2.2 Underground utility clearance and/or excavation permits, if required, must be obtained prior to commencement of any excavation activities. The Safety Specialists are responsible for verifying that all necessary excavation permits are on-site prior to commencing operations. The USACE Project Manager is responsible to ensure the appropriate agencies or companies mark the location of all subsurface utilities in the construction area. In the event subsurface utilities are suspected in the excavation area, the USACE Team must attempt to verify their location. All located utilities should be marked by paint, pin flags, or other appropriate means to visually delineate their approximate subsurface routing.

2.4.2.3 During mechanical excavation by backhoe or other capable machinery, one OE Safety Specialists will monitor all excavation activities in areas potentially contaminated with CWM/MEC/UXO. The individual should be positioned to the rear and upwind of the excavation equipment for continuous visual observation of activities. If the construction contractor unearths or otherwise encounters suspect CWM/MEC/UXO, all excavation activities will cease. The Safety Specialists will assess the condition of the MEC/UXO to determine if disposal action is required. If disposal is required, no further excavation is allowed at that location until an EOD response team has destroyed or removed the MEC/UXO item. In the event CWM is discovered the response process of paragraph 2.2 shall apply.

Mechanical excavation will be accomplished by a series of "lifts". Approximately six to eight inches of soil should be removed during each lift. Upon completion of each lift the spoils shall be spread of the ground and the OE Safety Specialists will visually investigate the spoils for MEC/UXO/CAIS vials. A combination of hand tools and magnetometer may be utilized during visual investigation of the spoils. The "lift" process will be repeated until native soil is reached.

*** Excavations less than 5 feet in depth and which a competent person examines and determines there to be no potential for cave-in do not require protective systems.**

2.4.2.4 An exclusion zone (EZ) for CWM/MEC/UXO is not required as the probability of encountering MEC/UXO is assessed as "Low" and the probability of encountering CWM is "Seldom" or "Unlikely". However, a safety work zone for heavy equipment operations will be established. This safety work zone is defined as a 50-foot radius around any heavy equipment that is operating. During excavation activities only the Safety Specialists, essential personnel and equipment operators will be permitted within the safety work zone.

2.5 Operations Sequence of Tasks

****In addition to the hazards posed by potential MEC/UXO, all personnel must remain alert for signs of HTW/CWM contamination. Suspicious odors, stained or discolored soils and unknown substances require immediate termination of excavation activities. The USACE team and equipment operator shall evacuate to a position upwind of the excavation. The USACE team will evaluate and notify appropriate authorities as the situation dictates.**

2.5.1 1918 West Cantonment Trench System

- **Area Preparation**

• The OE Safety Specialist will inspect and approve all hand and power tools to ensure the tools may be safely operated within a MEC environment.

• During brush cutting, either manual or mechanical, the OE Safety Specialists will monitor all activities and visually access all areas were brush/vegetation removal is to occur. The Safety Specialists may utilize hand-held magnetometers to assist during the visual assessment. Prior to field use of magnetometers, the OE Safety Specialists shall follow the guidelines of the manufacturer's operating manual for setup and test out procedures.

• Individuals utilizing hand tools or power tools (weed whackers, chain saws, etc.) may trim brush to a level not below six-inches above the surface level. Mechanized brush cutting may trim bush to a level not below 12-inches above the surface level.

• If suspect material is encountered the Safety Specialists will immediately halt operations and investigate the nature of the suspect item. If MEC/UXO is discovered all operations shall cease. UXO Technicians shall follow the guidance provided in previous paragraphs.

- **Latrine excavation.**

• The backhoe or other suitable excavator will be positioned up-wind of the excavation point. Streamers, attached to a stationary object, is a field expeditious method to monitor wind direction during excavation operations.

• The OE Safety Specialists will ensure all non-essential personnel are outside the perimeter of the 50-foot radius safety work zone.

• One OE Safety Specialists should be positioned to the rear and upwind of the excavation equipment for continuous visual observation of activities. Additionally the Safety Specialist will be positioned to ensure the swing arm radius of the backhoe is not a hazard to himself.

• If suspect material is encountered the Safety Specialists will immediately halt operations and investigate the nature of the suspect item.

- The equipment operator and the Safety Specialist will ensure communication signals are in place prior to starting excavations. The signals must include a "Stop Excavation" signal. The equipment operator must maintain visual contact with the OE Safety Specialist.

- Mechanical excavation will be accomplished by a series of "lifts" (Refer to paragraph 2.4.2.3).

- If MEC/UXO is discovered all operations shall cease. The OE Safety Specialists shall follow the guidance provided in previous paragraphs.

- **Removal of organic forest material from trenches.**

- The OE Safety Specialists will continuously monitor all raking and removal activities. Specifically the Safety Specialists shall be alert to any signs of MEC/UXO/ CAIS vials.

- If suspect material is encountered the Safety Specialists will immediately halt operations and investigate the nature of the suspect item. If MEC/UXO/CWM is discovered all operations shall cease. The OE Safety Specialists shall follow the guidance provided in previous paragraphs.

2.5.2 Shallow surface soil sampling and investigation of Gas Chambers and other structures of historical CWM association

- It is not anticipated MEC/UXO/CAIS vials are present in these areas as these areas are high tourist areas. However the OE Safety Specialist will remain vigilant and observe all sampling and reconnaissance activities.

2.5.3 MEC/UXO Documentation

The type of item, location (to include depth located), condition, amounts, and disposition of all MEC/UXO items will be recorded by the USACE OE Safety Specialists. All MEC/UXO containing energetic material or energetic residue will be photographed and all photographs will be provided to the USACE Project Manager or the USACE Project Team Leader.

3.0 REPORTS/LOGS

3.1 Daily Log

The USACE Safety Specialists shall maintain a daily log describing weather conditions, equipment on site, personnel and visitors on site, work performed, field problems encountered, a photograph log, and any other relevant field notes.

3.2 After Action Report

After Action Report will be prepared at the request of the Government Designated Authority.

3.3 Report of Suspect CWM

The USACE Team shall prepare a "Discovery of Recovered Chemical Warfare Materiel (RCWM). Reporting format is at Appendix C of the main WP. This format will be provided to CEHNC-OE-CW (Walters).

4.0 SAFETY

Prior to field activities commencing, a Site Safety and Health Plan (SSHP), prepared by the USACE, specifically addressing UXO/MEC/CWM activities must be submitted to CESPK-SO for review and approval.

APPENDIX C

Notification Procedures for Discovery of Recovered Chemical Warfare Materiel (RCWM) During USACE Projects

Notification Procedures for Discovery of Recovered Chemical Warfare Materiel (RCWM) During USACE Projects

RCWM NOTIFICATION FORMAT

CHEMICAL EVENT REPORT

FOUO

THIS IS A CATEGROY X CHEMICAL EVENT REPORT, RCS: CSGPO-453

1. Date, time and event number. (i.e.31Mar04, 1100 hrs) (event number-acronym of the organization doing the report locally (e.g., district acronym), year of the event and sequent number assigned locally (i.e., SPL 04-01)).

2. Project Title, Number/Location. (i.e., Big Mountain Manufacturing Facility, CA1234567, Big Mountain, CA).

3. Quantity and type of munitions/container and chemical agents involved. (Number of discovered items, markings (e.g., identification fixtures), condition of the item, is it leaking, concentration of agent and detection methods for both initial detection and confirmation. Include as much information available at the time of report). (i.e., pieces of crockery, one large piece with a small amount of liquid).

4. Description of what has happened. (Tell us why or how the item was found. Include as much detail as possible at the time of report). (i.e., Workers were removing a root ball from an arsenic contaminated area next to Bldg 384, Manufacturing Facility, Big Mountain, CA, Grid XXX-XX. This work was being accomplished under the Time Critical Removal Action for arsenic contamination from the Manufacturing Facility grounds. Workers were using a backhoe and hand held equipment to remove the root ball from a previous cut tree so they could remove the arsenic. At approximately 18 inches, pieces of crockery similar to that used during WWII was discovery. Team immediately covered the site with plastic and secured the area. Team also recovered a large piece of crockery and a grab soil sample before covering the hole. Personnel were wearing gloves and rubber boots; no respiratory (arsenic levels were being monitored) protection was being worn. Personnel were sent to Chemical Event Hospital (8 personnel). EOD was called to the site. EOD and TEU responded within 5 hrs. TEU was in Tyvek and approved respirators. Telephonic notification made to the Army Operation Center, USATCES and HQ USACE. DA MINICAM reading indicated H (mustard) and L (Lewisite) contamination. DAAMS tubes were taken and are being sent to Edgewood Arsenal for processing. THIS IS AN UNCONFIRMED UNTIL DAAMS TUBES ARE PROCESSED).

5. Emergency notification level. (Non-surety emergency, limited area emergency, post only emergency, community emergency. If not applicable, so state). (i.e., Non-surety emergency (informational)).

6. Description of property damage. (i.e., None.) Atch.

7. Personnel deaths and/or injuries. (i.e. 8 personnel were sent to CA National Hospital for medical check. No injuries have been reported).

8. Whether medical services and/or facilities were required. (i.e., See 7 above).

9. State if Service Response Force (SRF) commander is required. (i.e., None required).

10. Assistance required. (i.e., None required).

11. Any other pertinent information. (e.g., if news release was issue, safety and security measures taken, amount of agent release, weather patterns and/or conditions at the time of the event). (i.e. This work was being accomplished under a TCRA HTW contract. Area had been soil sampled and geophysical mapping accomplished. There was no indication of CWM but high arsenic reading. Excavation has been backfilled and construction fencing put around the site. It will be excavated under the Chemical Safety Submission when the other suspect CWM grids are excavated. Weather was normal).

12. Commander's assessment of the situation. (i.e No additional assistance is required. Situation is under control).

13. In reporting emergency destruction of the hazardous munitions (e.g., suspected chemical munitions or materials), reporting agencies must add the following: (i.e., N/A)

    a. Type of air samples and test kits used and results obtained.
    b. Type and amount of explosives used to destroy each munition.

14. Elements of media release. (i.e., None, as advised buy the district PAO until additional information is known).

15. Notification of senior government officials. (i.e., None made).

16. Points of Contact. (HNC and District POC, names, telephone numbers, mail address and/or Email).

(NOTE: Info in () contains directions/guidance on information required and when accompanied by _ is information regarding the sample).

AR 50-6, Figure 11-1 (USACE edited format, 23 Apr 2004)

APPENDIX D

Sampling and Analysis Plan

APPENDIX E - TABLE OF CONTENTS

INTRODUCTION

This Sampling and Analysis Plan (SAP) consists of two sections, one the Field Sampling Plan (FSP) and the second section consisting of the Quality Assurance Project Plan (QAPP). The SAP presents functions, procedures, and specific QA and QC activities to ensure that all project samples are collected and analyzed to generate data that will meet the project data quality objectives, defined in Chapter 3 of the Work Plan. It is necessary to define the sampling and analytical processes and procedures to support data of sufficient quality for the types of decisions that will be made. This site characterization effort is designed to assess that no Chemical Agent Identification Set (CAIS) materials or Chemical Warfare Material (CWM) residues are present within the Presidio of San Francisco (PSF).

When evaluating chemical agent contamination in the environment, it is necessary to realize that under many, if not most, environmental conditions, the agent will break down quickly. Therefore it will be necessary to determine the presence or absence of the chemical agent breakdown product (ABP) of the primary agent in the environment. The CAIS materials used and found previously at PSF were of the type that contained HD. When HD hydrolyzes in the environment, the breakdown products of 1,4-dithiane and 1,4-oxathiane.can persist. The presence of these agent breakdown products in soil can be used as an indicator of past HD contamination. The presence of 1,4-dithiane and 1,4-oxathiane will be used for this site investigation to evaluate possible release of HD from the CAIS materials used in military training at PSF.

1 FIELD SAMPLING PLAN

1.1 General Sampling Procedures

The site-specific field activities will include surface soil sampling at the sites specified in Table 2-1. All of the samples will be submitted for chemical analysis. All sample and/or grid locations will be identified by; 1) a Trimble Global Positioning System (GPS), 2) a ground survey, or 3) by field measurement from a known building or similar reference point. The reference grid is North American Datum (NAD) 1927, State Plane, California Zone VI (feet).

Table 1-1

General Sample Locations [A] and Sample Type

General Area	Name	Building Number	Type of Samples
West Presidio – Baker Beach (Figure 2)	Baker Beach Gas Chamber	NA	shallow soil sample
	Battery Chamberlin Gas Chamber	Bldg 1621	wipe sample(s)
	Baker Beach training area	NA	shallow soil samples
North Central Presidio - Cavalry Stables (Figure 3)	Bldg 672 Gas Chamber	Bldg 672	shallow soil sample
	CWS Storeroom	Bldg 670	wipe sample
	Chemical Corps	Bldg 667	bldg. present and renovated no sample
	Chem Warfare	Bldg 681	shallow soil sample wipe sample
	Cavalry Stables training area	NA	shallow soil samples
North East Presidio – Main Post (Figure 4)	CWS Warehouse	Bldg 94	shallow soil sample
	CWS Office	Bldg 219	shallow soil sample
	CWS Emerg/Office	Bldg 222	wipe sample
South Central Presidio - (Figure 5)	1918 West Cantonment Trench System	NA	shallow soil samples

Notes: [A] Proposed sample locations are indicated on Figures 2-5 (as listed above) of the SI Work Plan
NA - not applicable

Discrete soil samples will be collected from each of the site locations indicated in Table 1-1. All samples will be collected from shallow surface depths.

Wipe samples will be collected to determine residual ABPs that may remain on building structures that have not under gone renovation. The field team leader will use professional judgment in determining when and where to collect wipe samples at the remaining building locations indicated in Table 1-1.

1.2 Soil Sampling Summary

A summary of the soil samples planned for collection and the required QC samples is found in the table below.

Table 1-2

Summary of Planned Soil Samples for Analysis

Sample Locations	Planned Number of Soil Samples	Planned Number of Wipe Samples	Field Duplicate Soil Samples
Baker Beach Gas Chamber	1	-	-
Bldg 1621 Battery Chamberlin Gas Chamber	-	2	NA
Baker Beach training area	2	-	-
Bldg 672 Gas Chamber	1	-	-
Bldg. 670 CWS Storeroom	-	1	NA
Bldg. 667 Chemical Corps (renovated bldg.)	-	-	-
Bldg. 681 Chem Warfare	-	1	NA
Cavalry Stables training area	1	-	-
Bldg. 94 CWS Warehouse	1	-	-
Bldg. 219 CWS Office	1	-	-
Bldg 222 CWS Emerg/Office	-	1	NA
1918 West Cantonment Trench System	12	-	2

Notes:
N/A – Not applicable

1.3 Quality Control Samples

The following QC samples will be collected to assess precision and accuracy.

1.3.1 Field Duplicate Samples

Duplicate field samples provide information regarding precision for the entire measurement system including sample acquisition, homogeneity, handling, shipping, storage, preparation, and analysis. Field duplicates will be collected at a rate of approximately 10% of the primary soil samples. Due to the nature of a wipe being a single collection sample, field duplicate samples are not applicable for wipe samples.

1.3.2 Equipment Blank Samples

All non-disposable sampling equipment will be decontaminated using a standard protocol of potable water rinse, laboratory-grade detergent wash, potable water rinse and final rinse with deionized water. All decontaminated equipment will be placed in a clean area to air-dry.

To ensure that the sampling equipment has been successfully decontaminated, one equipment rinsate sample will be collected for every 20 environmental samples collected using non-disposable equipment. The equipment rinsate samples will be analyzed for ABP following the same protocols as the associated field samples collected during the sampling event. If all disposable equipment is used, no equipment blanks will be collected.

1.4 Quality Assurance Samples

Quality assurance samples, also known as split samples, will not be collected during this field effort. In the event that a remedial action such as soil removal is dictated, QA samples will be collected at the same time as the confirmation samples.

1.5 Sampling Equipment and Procedures

1.5.1 General Information

All fieldwork will be performed in accordance with the Work P and the Site Safety and Health Plan (SSHP). Records of the fieldwork will be kept in a bound notebook unique to this study. Photographs will be taken of each portion of the site before and during sampling activities to document site conditions. All sample locations will be recorded using GPS. The coordinates for each location will be used for mapping of the sample areas in the final report.

1.5.2 Surface Soil Samples

Discrete surface soil samples will be collected from the areas and depths identified in Table 1-2. These surface soil samples will be collected using a stainless sleeve either pushed or pounded into the ground to extract a sample. Samples collected in sleeves will be capped with Teflon™

squares and plastic caps. Soil will not be removed from the sleeve in the field. Alternatively, samples may be collected with disposable trowels and/or spoons, collected on pre-cleaned jars with Teflon™ lined lids. Regardless of collection method used, the samples will be labeled, placed in zippered plastic bags, stored in stored in coolers with temperature preservation, and sent to the laboratory via Federal Express under chain-of-custody protocol.

A backhoe will be used to dig a hole to the desired depth. The soil sample will be collected directly from the bucket of the backhoe using a stainless steel sleeve. Sleeves will be pushed into the soil in the bucket, then capped with Teflon™ squares and plastic caps. Samples will be labeled, placed in zippered bags, stored in coolers with temperature preservation, and sent to the laboratory via Federal Express under chain-of-custody protocol. See sections 1.9.2 and 1.9.3 for packing and chain of custody requirements.

1.5.3 Building Wipe Samples

Surface wipe samples will be collected from wall areas in buildings. Using a 4 "x 4" cotton gauze, sterile, pre-packaged wipe moistened with 10 mL of distilled water in a 4-oz. sampling jar. The wipe solvent may be modified based on the analytical method requirements for sample extraction and technical recommendations of the chemists in the surety lab processing the samples for analysis. The sampler performs the following steps:

- Prepare a 10 cm X 10 cm template wipe template.
- Identify specific sampling sites using the 10 cm X 10 cm template. Note due to the nature of a wipe being a single collection sample, no matrix spike, matrix spike duplicate, and field duplicate samples will be collected.
- Wearing clean disposable gloves, remove the distilled water moistened wipe from the jar, unfold the gauze material, and place it over the sampling site.
- With small movements, wipe the gauze material gently on the surface, remaining within the template 10 cm X 10 cm area. Do not touch edge of template.
- Fold the gauze wipe in two by bringing the two opposed parallel sides together, keeping the contaminated area to the inside, and wiping horizontally, wipe the same template site with the 2" X 4" gauze wipe, then,
- Fold the gauze wipe in two again by bringing the top and bottom together, keeping the contamination to the inside, wipe the same template site vertically with the resulting 2" X 2" gauze wipe.
- Replace the gauze wipe in the 4-oz. sampling jar, cap tightly and place in a cooler for transport to the laboratory under chain of custody procedures.

Samples will be labeled, placed in zippered bags, stored in coolers with temperature preservation, and sent to the laboratory via Federal Express under chain-of-custody protocol. See sections 1.9.2 and 1.9.3 for packing and chain of custody requirements.

1.6 Equipment Decontamination Procedures

All hand soil sampling equipment will be decontaminated using a non-phosphate detergent wash, tap water rinse, and deionized water rinse. Decontamination will be executed immediately prior to equipment use. Clean disposable gloves will be worn while decontaminating sampling equipment and tools.

1.7 Site Restoration

Upon completion of soil sampling using the backhoe, the excavation will be backfilled using the excavated soil. The soil will be compacted using the backhoe bucket and by driving the backhoe over the site.

1.8 Sample Containers and Preservation

Soil samples will be collected as described in Section 2.5.2. No chemical preservation will be required. Temperature preservation is required for all samples. The samples will be sealed, labeled, and stored in ice filled coolers. Temperature blanks will be used for all coolers with samples to determine adequacy of the temperature preservation. A summary of sample container and temperature preservation requirements is presented in the table below.

Table 1-3

Sample Size and Preservation

Method/Analysis	Sample Size and Container Requirements	Chemical Preservation	Temperature Preservation
SW8270D	Stainless steel sleeve or 4oz glass jar w/Teflon lid	None	Cool $4^0 \pm 2^0$C

1.9 Sample Documentation and Handling

1.9.1 Sample Numbering and Labels System

A unique identification number will be assigned to each sample. Each sample will be numbered and include the following information:

- project name (PSF)
- specific area of site using an initial designation (BBSA = Baker Beach Study Area) or applicable building number ((667, 670, 681 etc.)

- depth (in feet)

All information pertaining to a particular sample is referenced by its identification number. It is recorded on the sample container, in the field sampling log, and on the sample chain-of-custody form.

- Each sample collected at the site will be labeled with the following information:
- Project Name
- Sample identification number;
- Sample location;
- Date and time of collection;
- Name of person(s) collecting the sample;
- Analysis requested;
- Preservation; and
- Any other information pertinent to the sample.

1.9.2 Sample Packaging and Shipping

Samples will be transported to the laboratory for analysis as soon as possible after sample collection and preparation. The following procedures are to be used when packing and transporting samples to the laboratory:

- Use metal or equivalent strength plastic coolers or sturdy shipping containers,
- Package samples and temperature blank in individual plastic bags and place in container;
- Put paperwork (chain-of-custody record) in a waterproof plastic bag and tape it to the inside of the container,
- Tape the container lid and any drain shut with fiber-reinforced tape,
- Place at least two numbered and signed custody seals on container, one at the front right and one at the back left of cooler or container,
- Attach completed shipping label to the top of container and ship following the carrier's instructions.

Sample containers will be shipped via Federal Express for overnight delivery to the laboratory. A copy of the bill of lading (air bill) is to be retained and becomes part of the sample

custody documentation. The laboratory will be notified in advance of all shipments by telephone on the day of shipment and by advanced scheduling.

1.9.3 Chain-of-Custody Procedures

All samples will be accompanied to the laboratory by a chain-of-custody form (COC) form. The COC contains the following information:

- Project name;
- Sample numbers;
- Sample collection point;
- Sampling date;
- Time of collection of samples;
- Sample matrix description;
- Analyses requested for each sample;
- Preservation method;
- Number and type of containers used;
- Any special handling or analysis requirements;
- Signature of person collecting the samples;
- Signature of persons involved in the chain of possession.

The COCs will be filled out with ink. All information on the COCs shall match the information found on the label. When the samples are transferred from one party to another, the individuals will sign, date, and note the time on the form. A separate form will accompany each delivery of samples to the laboratory. The COC will be included in the container used for transport to the laboratory and the sampling personnel will retain a copy.

1.10 Investigation Derived Waste

It is anticipated that investigation derived waste consisting of decontamination water, personal protective equipment, and empty containers will be generated during the course of the fieldwork. Due to the low volume of decontamination water that will be generated (less than 5 gallons) and the low concentration of metals in the decontamination water from dilution with tap and deionized water, the decontamination water will be placed on the ground within the sampled

areas. Although not anticipated, if greater than 5 gallons are generated, decontamination water will be sampled for analysis and alternate disposal procedures will be followed. All other wastes will be disposed of in a trash receptacle.

2 QUALITY ASSURANCE PROJECT PLAN

This QAPP presents functions, procedures, and specific QA and QC activities to ensure that all analytical data are consistently produced and of known quality in order to achieve the data quality objectives defined in Section 2.0. The QAPP provides data specifications for all anticipated analyses and establishes procedures for data review and assessment. The QAPP format and elements were derived following EPA QA/G-5, *Guidance for the Preparation of Quality Assurance Project Plans* (EPA, 2002).

The purpose of this QAPP is to ensure that the data collected are of known and documented quality and useful for the purposes for which they are intended. The procedures described are designed to obtain data quality indicators for each field procedure and analytical method. Data quality indicators include following parameters including Precision, Accuracy, Representativeness, Comparability, and Completeness (PARCC). To ensure that quality data continues to be produced, systematic checks must show that test results and field procedures remain reproducible and that the analytical methodology is actually measuring the quantity of analytes in each sample.

The reliability and credibility of analytical laboratory results can be corroborated by the inclusion of a program of scheduled replicate analyses, analyses of standard or spiked samples. Regularly scheduled analyses of known duplicates, standards, and spiked samples are a routine aspect of data reduction, validation, and reporting procedures.

2.1 Analytical Methods Requirements

Table 3-1 provides a summary of the required analytical methods, parameters, and associated holding times required for this project.

Table 2-1

Summary of Analytical Method Requirements

Analytical Method	Analyte	Holding Time
SW8270D	1,4-oxathiane (CASRN 15980-15-1) 1,4-dithiane (CASRN 505-29-3)	14 days to extraction 40 days to analysis

If, during the course of a project, it becomes necessary to change analytical methods in order

to reduce matrix interferences or increase analyte sensitivity, the USACE Project Chemist will be notified and approval will be obtained. Unless authorized by the USACE Project Chemist, method quality control will be equivalent to the most current published version of the analytical method from SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (EPA, 2004), shall be used including all published updates.

2.2 Sample Preparation and Analysis

2.2.1 Analytical Method

The project soil samples will be analyzed by a modified SW-846 8270 at an off-site laboratory. Samples will be analyzed by a surety lab that is qualified to report analysis of both the parent agent and the breakdown products for that parent agent. The receiving laboratory will be capable of accepting all of the samples (none will be retained on-site) and will process them according to their laboratory protocols for analyzing samples containing potential CWA. A description of the required analytical calibration and method QC requirements are provided in Section 3.2.3 below.

2.2.2 Method Calibration and Quality Control Requirements

The analytical laboratory will provide analytical data for project samples following both the published method criterion and project specific quality control requirements and corrective action procedures. If a conflict is noted between the method's published criteria and the project specific criteria documented in Table 4-2 below, the project specific requirements and corrective actions as documented in this QAPP have precedence.

Table 2-2

Calibration and Internal Quality Control Procedures GC/MS Method

Quality Control Check	Minimum Frequency	Acceptance Criteria	Lab Corrective Action
Instrument tune - DFTPP (decafluorotriphenyl-phosphine)	Prior to initial calibration and every 12 hours of analysis time	Ion abundance criteria as described in SW8270D	Retune instrument and verify. Rerun affected samples.
Five-point calibration	When daily calibration verification fails or following major instrument maintenance or repair	1. Average RRF for SPCCs: ≥ 0.050. 2. %RSD for RRFs for CCCs: ≤30% 3. Calibration: Option 1: RSD for each analyte ≤15% Option 2: linear regression, r≥ 0.995 Option 3: non-linear regression – COD $r^2 \geq$ 0.990 (6 points 2nd order, 7 points 3rd order)	Correct problem then repeat initial calibration.
Second source calibration verification	Once after each initial calibration	% Difference from expected value ≤ 25% for all analytes.	Correct problem and verify second source standard. If that fails, then repeat initial calibration.
Calibration verification (CV)	Daily, prior to sample analysis and every 12 hours of analysis time	1. Average RRF for SPCCs: ≥ 0.050 2. %Difference/drift for CCCs: ≤ 20%D	Correct problem, rerun CV. If that fails, then repeat initial calibration.
Calibration verification internal standards (IS)	With every CV	Retention time ± 30 seconds from retention time of midpoint standard in the initial calibration. Quantitation ion peak area within 2 times area of initial calibration midpoint standard	Inspect mass spectrometer and GC for malfunctions. Take appropriate corrective actions. Reanalyze samples analyzed while system was malfunctioning.
Method Blank (MB)	1 per preparation batch	All analytes < ½ MQL. For common laboratory contaminants, all analytes < MQL.	Investigate possible contamination source. Take appropriate corrective action. Reprepare and reanalyze all samples processed with a contaminated blank, unless analyte is not detected in associated samples or present at greater than 10x blank concentration.
Laboratory Control Standard (LCS)	1 per preparation batch	Recovery limits: 50-120%	Correct problem, then reprepare and reanalyze LCS and all samples in the associated preparatory batch for failed analytes.
Matrix Spike and Matrix Spike Duplicate (MS/MSD)	1 MS/MSD per 20 project samples when identified on the Chain-of-Custody	Recovery limits: 50-120% and RPD <35 %	Evaluate for supportable matrix effect.
Surrogate spike	All field and quality control samples	Recovery limits: 50-120% See Table D-3 of the DOD QSM for specific surrogates and recovery requirements.	Evaluate for supportable matrix effect. If no interference is evident reprepare and reanalyze affected sample(s).

Quality Control Check	Minimum Frequency	Acceptance Criteria	Lab Corrective Action
Method Quantitation Limit standard (lowest concentration on initial calibration curve)	Verify at least once for every matrix and field effort	MQLs be no higher than the lowest five point calibration standard.	MQLs that exceed established criteria shall be submitted to USACE Project Chemist for approval prior to analysis of any project samples.

Notes:
All corrective actions associated with USACE project work shall be documented and the records maintained by the laboratory.
Test Methods for Evaluating Solid Waste, SW-846, USEPA, rev. 6, Nov. 2004.
CCV - Continuing Calibration Verification
COD – Coefficient of Determination
ICV – Initial Calibration Verification
LCS – Laboratory Control Sample
MQL – Method Quantitation Limit
RF – Response Factor
RSD – Relative Standard Deviation
USACE – US Army Corps of Engineers

2.3 Analytical Data Reduction and Review

The selected laboratory will be responsible for providing complete documentation of all analytical test results and QA/QC sample results in a comprehensive certificate of analysis.

2.4 Quality Assurance and Quality Control Procedures

Different types of replicate and blank samples are collected as part of the QA/QC program. Several QC samples will be analyzed for this project to provide a means to assess both field and analytical performance. The following sections describe the different types of QC samples and how they are assessed to evaluate data quality.

2.4.1 Field QC Checks

Field QC samples are discussed in Section 3.6and consist of field duplicate samples collected at a rate of 10% of the primary samples collected. Field QC samples undergo the same preservation, analysis, and reporting procedures as the related environmental samples. The following table summarizes the field QC sample collection frequencies and acceptance limits.

Table 2-3

Field QC Sample Collection Frequencies and Acceptance Limits

QC Sample Type	Minimum Collection Frequency	Acceptance Limits
Field Duplicate	1 per 10 investigative samples (10%)	RPD ≤ 50 %
Temperature Blank	1 per cooler	4º C ± 2º C

Notes:
QC – Quality Control

RPD – Relative Percent Difference

2.4.2 Analytical QA/QC Checks

The laboratory will have a QA/QC program that monitors data quality with internal QC checks. Those specific internal QC checks and frequency of checks are provided in Tables 4-2 and 4.3 and in the method-specific laboratory QA/QC procedures. These laboratory QC checks include blank samples, control samples, duplicate analyses, and matrix spikes / matrix spike duplicates.

2.5 Data Quality Indicators (DQI)

The DQI parameters are qualitative and quantitative statements regarding the quality characteristics of the data used to support project objectives and ultimately, environmental decisions. These parameters are presented in the remainder of this section.

2.5.1 Precision

Precision is a measure of the degree to which two or more measurements are in agreement, and describes the reproducibility of measurements of the same parameter for samples analyzed under similar conditions. A fundamental tenet of using precision measurements for QC is that precision will be bounded by known limits. Results outside these predetermined limits trigger corrective actions. Precision will be evaluated from field duplicate data, laboratory duplicate data, and MS/MSD data. Acceptable precision is achieved when RPD values are within the acceptance criterion.

2.5.1.1 Field Precision

Field precision objectives are met by collecting and measuring field duplicates at a rate of one duplicate per 10 environmental samples. The acceptance limit for field duplicate precision is ≤ 50 RPD. This precision estimate encompasses the combined uncertainly associated with sample collection, homogenization, splitting, handling, laboratory and field storage (if applicable), sub-sampling, sample preparation by digestion or extraction, and analysis.

2.5.1.2 Laboratory Precision Objectives

Laboratory precision QC samples (i.e., MS/MSD) will be analyzed with a minimum frequency of five percent. Acceptance limits for laboratory precision is ≤ 35 RPD.

2.5.2 Accuracy

Accuracy is the degree of agreement between an observed value and an accepted reference

value. This parameter is assessed by measuring spiked samples or well-characterized samples of certified analyte concentrations (e.g., LCS). Accuracy measurements are designed to detect biases resulting from the sample handling and analysis processes.

2.5.2.1 Field Accuracy Objectives

Field accuracy is maintained by monitoring adherence to procedures that prevent sample contamination or degradation. Accuracy also shall be improved qualitatively through adherence to all sample handling, preservation, and holding-time requirements.

2.5.2.2 Analytical Accuracy Objectives

Analytical accuracy is measured through the comparison of a spiked sample or LCS result to a known or calculated value and is expressed as a percent recovery (%R). MS/MSD analyses measure the combined accuracy effects of the sample matrix, sample preparation, and sample measurement. LCSs are used to assess the accuracy of laboratory operations with minimal sample matrix effects. Each spiked sample shall be spiked with representative target analytes for the analysis being performed to ensure that accuracy measures are obtained for each target analyte. Spiking concentrations shall be at of near the lowest standard of the calibration curve. Laboratory accuracy is assessed via comparison of calculated percent recovery values to accuracy control limits

.

2.5.3 Representativeness

Representativeness is an expression of the degree to which the data accurately and precisely represents a characteristic of a population or environmental condition existing at the site. Adherence to this work plan and use of standardized sampling, handling, preparation, analysis, and reporting procedures ensure that the final data accurately represent the desired populations. Representativeness will be evaluated during data assessment to evaluate whether each datum belongs to the observed data distribution through outlier testing. Any anomalies will be investigated to assess their impact on statistical computations as part of the report.

2.5.4 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount expected under normal conditions. Completeness is expressed as a percentage. Technical completeness is a measure of the amount of usable, valid laboratory measurements per matrix obtained for each target analyte. Usable, valid results are those that are judged, after data assessment, to represent the sampling populations and to have not been rejected

for use through data validation or data assessment. Analytical completeness objectives are 90 percent for each critical target analyte. The analytical completeness objective is 100 percent for sample holding times. Qualifications on the use of data caused by incomplete data sets will be documented in the report.

2.5.5 Comparability

Comparability is defined as the confidence with which one data set can be compared to another (e.g., between sampling points; between sampling events). Comparability is achieved by using standardized sampling and analysis methods and data reporting formats (including use of consistent units of measurement), and by ensuring that reporting and detection limits are sufficiently low to satisfy project detection and quantitation criteria for the duration of the project.

2.6 Data Reporting

All data shall be reported at the method detection limit (MDL) value where detects between the MDL and QL are qualified as estimated values. All positive results must be confirmed through evaluation of mass spectra.

At the conclusion of all analytical work for this project, the laboratory will report all analytical data in the form of comprehensive certificates of analysis. The actual MDLs and RLs for the instruments used for analysis will be provided in the analytical reports. The final certificates of analysis will be submitted no later than 21 days after collection of the last field sample.

2.7 Data Deliverables

The project laboratory shall provide sample data and all associated quality control data in hard copy and electronic data deliverable (EDD) format. The EDD will be submitted in the USACE Automated Data Review (ADR) format consistent with ADR version 4.0 specifications.

All electronic data submitted by the project laboratory is required to be error free, and in agreement with the hard copy data. Data files are to be delivered on a compact disk (CD) accompanied by the hard copy data reports. The CD must be submitted with a transmittal letter from the laboratory that certifies that the file is in agreement with the hard copy data reports, and has been found to be free of errors using the latest version of the compliance checking software

provided to the laboratory. Only the laboratory responsible for the generation of electronic data will be permitted to edit or alter the electronic results after they have been submitted.

2.8 Data Validation Requirements

The project team will review 100% of the data generated for the project. Data qualifiers will be assigned for the following QC outliers: contaminated blanks, LCS outliers, and MS/MSD outliers. Additionally, approximately 10 percent of the data will be validated at the raw data level (EPA level IV) to verify analyte detection and quantitation. Criteria evaluated in the full (level IV) validation of analytical data include the surrogate recoveries, spike recoveries (LCS, MS/MSD, preparation blanks, method blanks, instrument tuning, instrument calibration (including re-calculation verification of response factors), continuing calibration verifications, internal standard response, comparison of duplicate samples, and sample holding times.

3 REFERENCES

U.S. Army Center for Health promotion and Preventative Medicine (USACHPPM), 1999, *Primary Breakdown Products of Chemical Agent, Derivation of Health-Based Environmental Screening Levels for Chemical Warfare Agent,* March.

U.S. Environmental Protection Agency (EPA), 2002. *Guidance for the Preparation of Quality Assurance Project Plans*, EPA QA/G-5, Final, December.

U.S. Environmental Protection Agency (EPA), 2000. *Guidance on the Data Quality Objectives Process*, EPA QA/G-4, Final, September.

U.S. Environmental Protection Agency (EPA), 1999, *National Functional Guidelines for Organic Data Review*, EPA 540/R-94/012.

Department of Defense (DoD), 2006, *Quality System Manual for Environmental Laboratories*, rev3, January.

APPENDIX E

SITE SAFETY AND HEALTH PLAN

Chemical Warfare Materiel Site Investigation
Presidio of San Francisco
San Francisco, CA

Approved by: _____ Date: _____
A.R. Smith
Chief, Safety and Occupational Health

Prepared by: _____ Date: _____
David E Elskamp, CIH
Industrial Hygienist

_____ Date: _____
Bruce Handel
Project Manager

_____ Date: _____
Bradley Call, P.E.
Technical Team Leader

_____ Date: _____
Thomas Knapp
OE Safety Specialist

U.S. Army Corps of Engineers
Sacramento District

March 2006

This document was prepared using the guidance of ER 385-1-92 and Data Item Description MR-005-06. It is prepared for the sole use of the U.S. Army Corps of Engineers, Sacramento District

1.0 INTRODUCTION

This Site Safety and Health Plan (SSHP) establishes the responsibilities, requirements, and procedures for the protection of U.S. Army Corps of Engineers (USACE) Sacramento District (SPK) field personnel during site investigative activities (investigate for the presence of chemical agent identification set [CAIS] materials or chemical warfare materiel [CWM] residues) within the Presidio of San Francisco, San Francisco, CA.

1.1 *Policy Statement*

SPK's policy is to provide a safe and healthful work environment for site employees. Field personnel will receive the appropriate training, equipment, medical, and other resources necessary to complete assigned tasks in a safe manner.

1.1.1 Safety / Health Responsibilities

The Project Manager (PM), Technical Team Leader (TTL), SPK's Chief of Safety and Occupation Health (SO), Industrial Hygienist (IH), and OE Safety Specialist / Site Safety and Health Officer (SSHO) will cooperatively implement the requirements of this SSHP.

1.2 *Purpose*

The purpose of this SSHP is to heighten awareness of the hazards present, enhance the safety and health of SPK's field personnel, and provide guidelines for emergency response. This SSHP is written to meet the safety and health requirements in EM 385-1-1 and ER 385-1-92 as well as OSHA requirements (29 CFR 1926.65 / 29 CFR 1910.120). This SSHP describes the safety and health guidelines to protect on-site personnel, off-site receptors, and the environment. The procedures and guidelines contained herein are based upon the best available information regarding the physical, chemical, biological, radiological, and safety hazards known, or suspected to be present on the project site at the time of this SSHP's preparation. Specific requirements may be revised if new information is received or site conditions change. Any revisions to this plan will be made with the knowledge and concurrence of the TTL, SO, IH, and OE Safety Specialist. This SSHP will supplement any contractor's (TBD) Accident Prevention Plan (APP) in support of this project.

Based upon site history, anticipated chemicals of concern, and planned activities, a "Level D" site will be maintained. As work activities progress, site conditions may require a change in the level of PPE. Any PPE changes will be addressed in the tailgate safety meeting.

1.3 *Compliance*

SPK personnel will comply with this SSHP and any contractor prepared APP, applicable Federal, state and local occupational safety and health regulations.

1.4 *Applicability*

SPK field personnel are responsible for reading, understanding and abiding by this SSHP and documenting such understanding through signing the Employee Acknowledgment Form.

1.5 *References*

This SSHP and subsequent activities will comply with the following referenced documents, at a minimum:

a. Title 29 Code of Federal Regulations (CFR) 29 CFR 1926.65 / 29 CFR 1910.120, *Hazardous Waste Operations and Emergency Response*.
b. USACE, *Safety and Health Requirements Manual*, EM 385-1-1.
c. USACE, *Safety and Occupational Health Document Requirements for Hazardous, Toxic and Radioactive Waste (HTRW) Activities*, ER 385-1-92.
d. USACE, *Munitions and Explosives of Concern (MEC) Support During Hazardous, Toxic, and Radioactive Waste (HTRW) and Construction Activities*, EP 75-1-2.
e. CEHNC-ED-SY-S, *Data Item Description (DID)*, MR-005-06.
f. USACE, *Archive Search Report, Presidio of San Francisco*, (2003)
g. Interim Guidance, Interim Guidance for Biological Warfare Materiel (BWM) and Non-Stockpile Chemical Warfare Materiel (CWM) Response Activities, September 4, 1997; and Memorandum, Applicability of Biological Warfare Materiel and Non-Stockpile Chemical Warfare Materiel Response Activity Interim Guidance, March 19, 1998.
h. NIOSH/OSHA/USCG/EPA, *Occupational Safety and Health Guidance Manual for Hazardous Waste Activities*.

1.5.1 SPK-OM-385-1-1

In addition to the information contained in this SSHP, SPK's Safety and Occupational Health Policy and Procedures Manual (OM 385-1-1) will be implemented for this project.

1.6 *Activity Hazard Analyses (AHAs)*

The attached Activity Hazard Analyses (AHAs) becomes a part of this SSHP. The analyses identify the specific hazards anticipated, the control measures to be implemented to eliminate or reduce each hazard to an acceptable level and contingency planning in the event of an emergency. Before activities begin, the SSHO and contractor will conduct a safety and health tailgate meeting to discuss the AHAs.

1.6.1 SPK Tasks

Detailed description of work tasks is described in the Work Plan (WP). Work will involve selective removal of vegetation, raking forest duff out of trenches, check for CAIS material, excavation of latrine pits, soil sampling for chemical agent break-down products, and UXO construction support. Hand tools, small tractors, and all-terrain vehicles may be used. The OE Safety Specialist will monitor all activities and visual access all areas where brush/vegetation removal is to occur. The OE Safety Specialists may utilize hand-held magnetometers to assist during the investigation. Appendix B of the Work Plan contains the Unexploded Ordnance (UXO) Work Plan.

1.6.2 Contractor Tasks

The contractor's work task includes vegetation removal and excavating potholes. Vegetation removal cannot occur between March 1 and August 15 (bird nesting season). Vegetation removal will be accomplished using small power tools such as chainsaws, weed-wackers, and similar field portable equipment. This will be supplemented with hand tools such as shears and handsaws.

2.0 SITE DESCRIPTION AND CONTAMINATION CHARACTERIZATION

A detailed discussion of the site background and history is included in the Work Plan (WP). Site background that is germane to the development of this SSHP is discussed in this plan.

2.1 *Location*

The project sites are located at the former Presidio of San Francisco (Presidio), within the City of San Francisco, at the northern tip of the San Francisco Peninsula. The Presidio is approximately 1,416 acres in size.

2.2 *History*

The Presidio was established in 1776 as a military garrison by the government of Spain, which it held until the formation of the Mexican Republic in 1822. The Presidio was formally ceded to the United States from Mexico in 1848. The Presidio has served as a mobilization and embarkation point during several overseas conflicts, a medical debarkation center, and coastal defense for the San Francisco Bay area. From 1933 to 1937, the Golden Gate Bridge was build, increasing public use of the Presidio. In 1994, the Presidio became part of the Golden Gate National Recreation Area (GGNRA). Prior to transfer of the property to the Department of the Interior and Presidio Trust, the Presidio was a multi-mission installation with various military activities conducted under separate commanders stationed as tenants or satellites. The Presidio of San Francisco is presently managed jointly by the National Park Service and the "Presidio Trust".

2.3 *Proximity to the Public*

Field personnel should be cognizant of public access to the sites.

2.4 *Meteorological Conditions*

The Pacific Ocean and San Francisco Bay have a strong influence on the climate of the Presidio. The temperature is moderate; rain and mild temperatures characterize the winter months, and spring is usually sunny and mild. Fog often occurs in summer when warm, moist air is cooled by cold ocean water along the coast. The average annual rainfall is 19.5 inches. Ninety percent of the rainfall occurs from November to April.

2.5 *Topography*

Elevations at the Presidio range from sea level along the northern and western boundaries to approximately 400 feet above seal level in the south-central portion of the Presidio.

Baker Beach is at the base of steep slopes. The interior portions of the Presidio are characterized by gently rolling to hilly topography.

2.6 *Vegetation*

Much of the vegetation at the Presidio results from years of planting by the Army in a program that began in the 1880s to provide both windbreaks and scenic beauty. Isolated enclaves of endangered plants are found at the Presidio.

2.7 *Previous Investigations*

The Archive Search Report (ASR) identifies three CWM locations for further evaluation. These are the 1918 West Cantonment Trench System, the Baker Beach Gas Chamber and the Building 672 Gas Chamber. A number of additional buildings and possible training areas will be included in this investigation: Battery Chamberlin Gas Chamber; Baker Beach training area; Chemical Warfare Service (CWS) Storeroom (Building 670); Chemical Corps (Building 667); Chemical Warfare (Building 681); Cavalry Stables training area; CWS Warehouse (Building 940; CWS Office (Building 219); and CWS Emerg/Office (Building 222). The exact nature of the CWM related activities is not known and can only be inferred from a general understanding of events occurring during the period when chemical agents were potentially used during training (the 1920s through the 1950s). The locations of the ten individual sites that are the subject of this project are identified in Figure 1 of the WP.

In October 2002 Presidio Trust volunteers found four glass bottles from a K914 CAIS at the 1918 West Cantonment Trench System. The U.S. Army Technical Escort Unit (TEU) removed the bottles. Subsequent analyses by the U.S. Army of the residue contents of the bottles indicated the presence of HD, a type of CWM. HD, also commonly called mustard agent, mustard gas, or sulfur mustard, is a non-volatile, colorless to pale yellow liquid with a garlic or horseradish odor, and was developed as a blistering agent. The area of the discovery was fenced to prevent access by the public.

The 2002 discovery of CAIS bottles prompted the preparation of the ASR. This report confirmed that the Army had trained with CWM on post. CWM training included limited quantities of bulk mustard agent and all three types of CAIS (i.e., instructional, detonation, and toxic sets). The chemical warfare training facilities at the Presidio consisted of a number of gas chambers and training areas used over the years, some of which were clearly identified and others, which were not. The ASR did not identify any overt indication of a CWM hazard at the Presidio.

The October 2002 location of CAIS vials confirms that in fact CAIS were trained with on the PSF. Because CWM materials were discovered, a CWM Probability Assessment for all areas of the planned investigative work was conducted and the Sacramento District Commander authorized work to proceed as "non-CWM activity". The conclusions of the CWM Probability Assessment are attached to the WP.

2.7.1 General Notes on Chemical Warfare Training

Chemical warfare training in the United States began with the mobilization during World War I (approximately 1917). Troops were trained to protect themselves from exposure to the chemical agents used at that time (e.g., chlorine, phosgene, and mustard). Training included familiarization with the equipment, test fitting of the gas mask, decontamination training, and tactical exercises in which simulated or training chemical agents were employed. Chemical warfare materials were stored at the Presidio and this included statically used munitions filled with smoke, riot control agents and simulants, in addition to CAIS material and bulk mustard agent (the bulk mustard containers were apparently used in the 1920s). Dynamically used munitions, such as rifle grenades and hand grenades, which could be filled with riot control agents and simulants, were also present in military unit inventories. Chemical warfare items included candles, capsules, grenades, pots, bombs, smoke generators and land mines. Some of these items were stored for use in the event of combat deployment while other items were used for routine training. CAIS sets were used from the early 1930s to the late 1950s. The estimated periods of use at the Presidio's sites are included in Table 2 of the WP. The term "gas chamber" refers to a small room in which simulants or riot control agents are used to create conditions to test the fit of gas masks as well as to instill confidence that the masks are protective.

3.0 HAZARD/RISK ANALYSIS

This SSHP identifies the chemical, physical, biological, radiological, and safety hazards that may be encountered.

3.1 *Chemical Hazards*

Contaminants of Concern (COCs) include chemical warfare agents, chemical warfare agent's break-down products and simulants.

Between 1928 and 1969, the U.S. Military fielded a number of Chemical Agent Identification Sets (CAIS) containing toxic agents for training. All three types of CAIS were used at Presidio (instructional, detonating and toxic sets). Although the CAIS kits included toxic agents such as the H-series mustard, lewisite, phosgene, and chloropicrin, they never contained nerve agents (i.e. V- or G series). Mustard and Lewisite are blistering agent that causes injury based upon direct contact with the material or inhalation of mist. Phosgene is a choking agent used as a delayed-casualty agent resulting in fluid buildup in the lungs. Chloropicrin is a tear agent that cause severe respiratory irritant. Exposure to CWM is expected to be minimized through proper work practices, the use of PPE and proper personal hygiene. All materials will be handled with rakes and shovels or other devices, as appropriate.

Table 3-1 – Occupational Health Exposure for COCs

COC	OSHA PEL PPM	ACGIH TLV PPM	IDLH PPM	Physical Description/Health Effects/Symptoms
Chloroacetophenone (CN)	0.05 0.32 mg/m^3	0.05	15 mg/m^3	Riot control agent (tear agent). Colorless crystalline solid with a pungent apple blossom fragrance. Irritates eyes and skin.
o-Chlorobenzylidene malonitrile (CS)	0.05 (ceiling) (skin)	0.05 (ceiling) (skin)	2 mg/m^3	White, crystalline, riot control agent, with a pepper-like odor. Highly irritating but not toxic to eyes, skin, and respiratory system. Causes painful and burning eyes, tearing, conjunctivitis, twitching eyelids, irritated throat, coughing, chest tightness, headaches, and red and blistered skin. Mutagen
Gasoline	NA	300	NA	Clear/amber flammable, volatile liquid with a characteristic odor. Irritates eyes, skin, and mucous membranes. Causes dermatitis, headaches, fatigue, blurred vision, dizziness, slurred speech, confusion, convulsions, chemical pneumonia, and possible liver and kidney damage.
Mustard (HD)	0.003 mg/m^3 (ceiling)	NA	NA	Blister agent. Yellow, oily liquid. Garlic odor. Reddening of skin or appearance of blisters may occur several hours after exposure.
Lewisite (L)	0.003 mg/m^3 (ceiling)	NA	NA	Blister agent. Dark oily liquid with geranium-like odor. Affects eyes, lungs, and blisters skin. Acts as a systemic poison, causing pulmonary edema, diarrhea, restlessness, weakness, subnormal temperature, and low blood pressure. Experimental teratogen.
Phosgene (CG)	0.1	0.1	2	Colorless gas (fuming liquid) with a suffocating odor like musty hay or green corn. Choking agent. Irritates eyes, skin, and respiratory system. Causes dry and burning throat, cough, vomiting, chest pain, frothy sputum, shortness of breath, pulmonary edema, pneumonia, blue skin, and frostbite (liquid).
Chloropicrin (PS)	NA	NA	NA	Colorless, oily liquid with a stinging pungent odor. Chloropicrin is a powerful irritant whose vapors cause lung, skin, eye, nose and throat irritation, coughing and vomiting. As an eye irritant, it produces immediate burning, pain and tearing.
1,4-Oxathiane	NA	NA	NA	Mustard breakdown product. Health affects not available.
1,4-Dithiane	NA	NA	NA	Mustard breakdown product. Health affects not available.
Thiodiglycol	NA	NA	NA	Mustard breakdown product. May cause eye and skin irritation. May be harmful by inhalation, ingestion, or skin absorption.

N/A - Not applicable or available

3.1.1 Chemical Information and Material Safety Data Sheets (MSDS)

Prior to the commencement of work, all available information concerning the chemical, physical, and toxicological properties of each substance known or expected to be present on site will be made available to the affected employees. MSDS will be provided for chemicals brought to the site.

3.2 *Physical Hazards*

Potential hazards from physical agents include noise, heat and cold stress, solar radiation, weather, lifting, working around heavy equipment, slipping, tripping, or falling, underground and overhead utilities, being struck by or caught between moving parts, and fire from flammable materials.

3.3 *Biological Hazards*

Biological hazards include poisonous plants (poison oak), domesticated animals, insects (brown recluse and black widow spiders, ticks, and flying insects), snakes and rodents.

a. Snakes and insects are found throughout the site. Possible cover and habitat for these shall be minimized in the field operations area (i.e., weed control, organized storage).
b. Poison Oak is present throughout the area. This deciduous perennial plant may develop bush, creeper or climbing branch structures and may produce dermal allergic reactions resulting from contact with any part of the plant.

Workers should also be aware that if there is evidence of the presence of rodents, hazards associated with exposure to Hantavirus may also be present. Site personnel must avoid direct contact with dead rodents or dried fecal material.

Site personnel will wear leather work gloves whenever moving debris; and to watch for an avoid spiders, snakes, or rodents.

3.4 *Radiological Hazards*

There is no evidence of ionizing radiation sources or radioactive waste disposal at this site; therefore, no specific radiation screening is planned.

3.5 *Safety Hazards*

Safety hazards include slips, trips, and falls on same surface, electrical, equipment and machinery, and weather. SPK will ensure that the controls implemented to address these safety hazards comply with applicable sections of EM 385-1-1.

3.5.1 Heat Stress, Cold Stress and Solar Radiation

Due to local variability in weather patterns, it is likely that weather conditions varying from cold to hot may be encountered. Wind and moisture may combine with low or high temperatures to create unfavorable working conditions. The SSHO will observe the site conditions and, should adverse conditions occur, implement appropriate work/rest regimes to provide for the comfort and safety of personnel. In addition, the SSHO will routinely check with site personnel to verify that they are not uncomfortably cold or hot.

3.6 *Ordnance and Explosives (OE)*

There have been no reported discoveries of MEC/UXO on these sites however the ASR noted "Training with grenades and possibly other munitions" occurred within the area of the 1918 West Cantonment Trench System. Because there may be MEC present at this location, the USACE will, in accordance with EP 75-1-2, provide MEC standby support during all investigative process. Two USACE OE Safety Specialists will provide the required standby support during investigative activities within the 1918 West Cantonment Trench System. Although not required the USACE will provide one-USACE OE Safety Specialist during the conduct of investigative activities at the other sites.

3.7 *Hazard Analysis*

This SSHP address the specific means of controlling and mitigating the safety, chemical, physical, and biological hazards. The IH conducted the hazard analysis/hazard assessment.

3.7.1 Heavy Equipment Operations

Prudent care will be exercised when moving about machinery of any kind. Personnel will be aware that the use of certain protective equipment may limit dexterity and visibility, and may increase the difficulty in performing certain tasks. The equipment will be operated by contractor persons trained in its use and safety precautions.

3.7.2 Vehicle Traffic

Employees may be exposed to vehicle accidents; safety procedures will be strictly enforced.

3.7.3 Heavy Lifting

During manual lifting tasks, all personnel will lift with the force of the load suspended on their legs and not their backs. They are to maintain a straight back and hold the object close to the body. Mechanical lifting devices or help from a fellow field team member will be sought when the object is too heavy for one person to lift.

3.7.4 Slip/Trip/Fall

All field members are to be vigilant in providing clear footing, identifying obstructions, holes or other tripping hazards, and maintaining an awareness of uneven terrain and slippery surfaces. If necessary, shoes providing more elaborate tread will be worn to minimize slip, trip, and fall hazards. Good housekeeping will be maintained to minimize slip and fall hazards.

3.7.5 Noise

Excessive noise from the on-site equipment is not expected to occur. All field personnel are required to wear hearing protective devices having a Noise Reduction Rating (NRR) adequate to attenuate noise below 85 dBA in all active areas where normal communication cannot be understood when field personnel are within three feet from one another.

3.7.6 Pinch/Crush Injuries

Field members will be vigilant and avoid pinching/crushing injuries. Heavy work gloves and steel-toed boots are required. OE Safety Specialists are not required to wear steel-toed boots as the steel toe imparts unwanted magnetic influences to the magnetometer.

3.8 *Hazard Communication Program*

SPK will implement a hazard communication program for this project. Details regarding this program are found in 29 CFR 1926.59 and OM 385-1-1.

4.0 STAFF ORGANIZATION, QUALIFICATIONS, AND RESPONSIBILITIES

Each person assigned specific safety and health responsibilities is identified. The organizational structure, with lines of authority and overall responsibilities for safety and health will be discussed. Qualified and competent safety and health professionals will undertake the operational and safety and health responsibilities.

4.1 *Chain of Command*

Mr. Bruce Handel is the Project Manager, Mr. Bradley Call is the Technical Team Leader, Mr. Thomas Knapp is the OE Safety Specialist and designated Site Safety and Health Officer, and Mr. David Elskamp is the IH.

4.2 *General*

SPK personnel are responsible for performing functions in a safe and healthful manner, preventing unnecessary risk of hazardous exposure to other site personnel, the public, or the environment. Each individual is responsible for acknowledging and following applicable safe work rules and guidelines in this SSHP and the contractor's SSHP, and using best professional judgment in minimizing the potential for injury or adverse health associated with activities governed by this SSHP.

4.3 *Project Manager*

As the senior management representative, the PM is responsible for defining project objectives, allocating resources, determining the project delivery team, and evaluating project outcome. The PM is responsible for contacting the client should a health and safety issue arise.

4.4 *Technical Team Leader*

As the senior management representative on site, the TTL has overall responsibility for implementation of the field activities. He will execute all activities in accordance with the Work Plan and SSHP.

4.5 *OE Safety Specialist / Site Safety and Health Officer*

Day-to-day safety and health support, including OE construction support, initiate emergency procedures and notifications, training, daily site safety inspections, will be provided by the OE Safety Specialist / SSHO who will report activities to the IH.

4.6 *Field Personnel*

All persons covered by this plan will sign a personal acknowledgment form signifying that they have read and will abide by the plan. Additionally, all personnel will attend a project-specific briefing conducted by the OE Safety Specialist / SSHO. This briefing is used to orient site personnel to the nature of the site, the scope of work, the contents of the SSHP and any unique site conditions that warrant explanation.

4.7 *Industrial Hygienist*

The IH is responsible for the development, technical assistance, and oversight of this SSHP. The IH will ensure that all health and safety program documents comply with

Federal, state and local health and safety requirements. If necessary, the IH will modify the SSHP to adjust for on-site changes that affect safety and/or health. The IH will coordinate with the OE Safety Specialist / SSHO on all modification to the SSHP and will be available for consultation when required. The IH may visit the site periodically during the project to evaluate the effectiveness of the health and safety program and compliance with the SSHP.

4.8 *Chief, Safety and Occupational Health Office*

The Chief, SO is responsible for verifying that SPK personnel are current participants in the medical surveillance program, have current respiratory fit test (if applicable), complete safety and health training; and providing quality assurance for consistency with Corps policy and procedure. The SO may conduct a site safety audit.

4.9 *Other Key Safety and Health Personnel*

a. SPK will utilize the services of Dr. Lee Wugofski, MD, of the Division of Federal Occupational Health (DFOH) unit. Dr Wugofski is certified in occupational medicine.
b. SPK will utilize laboratories which are proficient to conduct personnel, area, and environmental analysis as required; fully equipped to analyze the required NIOSH, OSHA, and EPA analyses; and currently participating in the American Industrial Hygiene Association (AIHA) Proficiency Analytical Testing (PAT) Program and is certified by AIHA.

4.10 *Key Personnel*

U.S. Army Corps of Engineers, South Pacific Division Range Support Center

Project Manager	Bruce Handel	(916) 557-7906
Technical Team Leader	Bradley Call	(916) 557-6649
OE Safety Specialist / SSHO	Thomas Knapp	(916) 557-7313
Cell Phone		(916) 752-0354
Chief SO	Arthur R Smith	(916) 557-6973
Industrial Hygienist	David E Elskamp	(916) 557-7903
Project Chemist	Pam Werhmann	(9160 557-6662
Environmental Engineer	Jennifer Payne	(916) 557-7521

U.S. Army BRAC Environmental Coordinator:

BEC	Roger Caswell	(510) 909-4804

U.S. Army Engineering and Support Center, Ordnance and Explosives Directorate in Huntsville Alabama:

MM CX	Hank Hubbard	(256) 895-1586
MEC Design Center	Bill Veith	(256) 895-1592
CWM Design Center Operations Officer	Wilson Walters	(256) 895-1290

Presidio Trust:

Environmental Program Manager	Craig Cooper	(415) 561-4259

Environmental Remediation Specialist	Jennifer Yata	(415) 561-4272
National Park Service: Environmental Engineer	Brian Ullensvang	(415) 561-4439

4.11 *Site Visitors*

Visitors may be present at the project site during field activities. These individuals may include SPK staff, regulatory agency personnel, client personnel, and visitors. Providing a general viewing area at a safe location in the support zone most likely can accommodate these visitors. The OE Safety Specialist / SSHO will provide a brief overview of the field activities to the site visitors. Any visitor wishing to enter the regulated area must provide verification to the OE Safety Specialist / SSHO that shows they meet the 29 CFR 1926.65 / 29 CFR 1910.120 standard. The OE Safety Specialist will escort visitors in the regulated area.

5.0 TRAINING

5.1 *General*

All personnel who enter this site must recognize and understand the potential hazards to health and safety. It is the intent of this SSHP to provide every person a level of health and safety training consistent with their job function and responsibility. SPK on-site personnel have completed formal hazardous waste operations (HAZWOPER) training and will complete an on-site briefing on this SSHP, the AHAs, PPE, heavy equipment operation, and hazard communication. SPK personnel performing on-site activities will be familiar with the contents of this SSHP along with the Contractor's SSHPs.

5.2 *Additional Training*

In addition to the OSHA hazardous waste operations and emergency response regulations, there are other ancillary safety and health regulations that may govern certain training aspects for this project. These additional training requirements include:

a. Respiratory Protection (29 CFR 1910.134).
b. Hearing Conservation (29 CFR 1910.95).
c. Hazard Communication (29 CFR 1910.1200/29 CFR 1926.59).

5.3 *Initial HAZWOPER Training*

Field personnel have completed 40 hours of off-site instruction, and a minimum of three days actual field experience under the direct supervision of a trained, experienced supervisor.

5.4 *Supervisory Training*

The OE Safety Specialist / SSHO responsible for supervising personnel engaged in site work has at least 8 additional hours of specialized training on managing such operations.

5.5 *Refresher Training*

All site workers will complete 8 hours of off-site refresher training annually on the items covered in the 40-hour initial HAZWOPER training program.

5.6 *Site-Specific Training*

The OE Safety Specialist / SSHO will conduct initial site-specific training to ensure that employees have a thorough understanding of the SSHP, standard operating procedures (SOPs), and physical, safety, biological, and chemical hazards of the site.

5.7 *Daily Tailgate Safety Meetings*

All personnel who enter the regulated area will attend the daily tailgate safety meeting. This meeting, conducted by the OE Safety Specialist / SSHO and contractor, will cover specific health and safety issues, site activities, changes in site conditions, review topics covered in the initial health and safety meeting as they apply to daily activities.

5.8 *Respiratory Protection*

Respiratory protection training is provided in the HAZWOPER training.

5.9 *Hazard Communication*

In accordance with the OSHA Hazard Communication standard (29 CFR 1910.1200 / 29 CFR 1926.59), copies of all material safety data sheets (MSDS), container labeling, and chemical health hazards for hazardous chemical materials brought onto any project site and used during site operations will be available. Site-specific training on the COCs will be provided. General hazard communication training will be conducted during the HAZWOPER training.

5.10 *CPR/First Aid*

The OE Safety Specialist / SSHO will provide CPR/First Aid if the event of an injury.

5.11 *Hearing Conservation*

Hearing conservation is included in the initial 40-hour and 8-hour HAZWOPER training classes.

5.12 *Emergency Response Procedures*

All employees will be aware of the project emergency assistance network and the most probable route of evacuation from a site in the event of an emergency. Emergency phone numbers and hospital route map will be maintained in each field vehicle.

5.13 *Site-Specific Rules*

Prior to the initiation of site activities, employees will be instructed in specific safety rules. Employees will be instructed in the use of the “buddy” system; the buddy system will be used at all times when employees are within a regulated area.

5.14 *Documentation of Training*

Documentation of training is the responsibility of SO. The SO will keep documentation of each worker's current training credentials.

6.0 PERSONAL PROTECTIVE EQUIPMENT

6.1 *Personal Protective Equipment Program*

This site-specific PPE program supplements SPK's Protective Clothing and Equipment Program (Appendix J of CESPK OM 385-1-1). This program address the elements of 29 CFR 1926.65(g)(5) / 29 CFR 1910.120(g)(5), 29 CFR 1910.132 (General Requirements) and 29 CFR 1910.134 (Respiratory Protection).

6.2 *Site-Specific Personal Protective Equipment*

Based on the hazard assessment, site history, previous site activities, anticipated chemicals of concern, planned activities, and potential heat stress and associated safety hazards; a Level D PPE site will be maintained. The U.S. Environmental Protection Agency terminology of Levels D is used to describe the general PPE ensembles.

6.2.1 Level D

Level D consists of the following:

a. Sleeved shirt with collar, and long pants. When working in areas with poison oak, breathable Tyvek® coveralls will be used for added protection. Field personnel should avoid contact with poison oak, and use barrier creams when exposure is possible. Exposed skin and/or contaminated tools and equipment should be washed carefully with detoxification/wash solutions at the end of each workday.
b. Safety boots/shoes meeting the specifications of American National Standards Institute (ANSI) Z41.
c. Safety glasses with side shields, goggles, face shield or other approved eye protection. All approved eye protection must meet the specifications of ANSI Z87.1.
d. Work gloves with the addition of impervious gloves (butyl rubber) during site activities that could result in direct contact with potentially contaminated soil, water, poison oak or other items.
e. Hearing protection (if required). The protective device must have a noise reduction rating capable of providing the wearer with enough protection so as to reduce the received noise level to below 85 dBA.
f. Reflective traffic vests if working in high traffic areas.
g. Hardhat when an overhead hazard exists. All approved hard hats must meet the specifications of ANSI Z89.1.

The use of respiratory protection is not anticipated during site activities.

6.2.2 Level C

Level C protective equipment is not anticipated. If atmospheric conditions indicated the use of Level C protection is needed, the site work will stop pending an evaluation by the IH.

6.3 *Fit-For-Duty*

Site workers will have a current medical "fit-for-duty" clearance to use respiratory and other PPE.

6.4 *Respirator Protective Program*

All respiratory protective equipment will be National Institute for Occupational Safety and Health (NIOSH) approved. SPK maintains a written respiratory protective equipment program (Appendix O to SPK OM 385-1-1), detailing selection, fit testing, use, cleaning, maintenance, and storage of respiratory protective equipment, as well as medical approval for individual use.

6.5 *PPE Storage*

Clothing and respirators will be stored properly to prevent damage or malfunction due to exposure to dust, moisture, sunlight, damaging chemicals, extreme temperatures, and impact. Potentially contaminated PPE will be stored separately from new PPE and street clothing.

7.0 MEDICAL SURVEILLANCE

7.1 *General*

Personnel performing on-site HTRW activities participate in an ongoing medical surveillance program meeting the requirements of 29 CFR 1910.120 / 29 CFR 1926.65 and ANSI Z-88.2.

7.2 *Medical Surveillance Coordinator*

SO has contracted the services of a Board-Certified Occupational Physician at DFOH to provide the bi-annual (more frequent on physicians recommendation) medical surveillance exams. The physician will review all medical examinations and will be available for medical consultation on an “as-needed” basis.

7.3 *Medical Examinations*

Field personnel have successfully completed a pre-placement or periodic/updated physical examination. The medical surveillance includes a judgment by the medical examiner of the ability of the employee to use negative-pressure respiratory equipment. Any employee found to have a medical condition, which could directly or indirectly be aggravated by exposure to the COCs or by the use of respiratory equipment will not be assigned to the project.

7.3.1 Contents of Medical Examination

SO in consultation with the DFOH has established the minimum content of the medical examination based upon probable HTRW site conditions, potential occupational exposures and required protective equipment.

7.3.2 Certification of Participation

SO will maintain the certification of employee participation in the medical surveillance program and the written opinion from the attending physician.

7.4 *Medical Records*

Personnel Medical records will be maintained by DFOH.

7.5 *Medical Evaluation*

a. Occupational History
b. Personal History
c. Physical Examination
d. Laboratory Blood Tests
e. Other Biological Tests
f. Pulmonary Function Tests
g. Vision Tests
h. Hearing Test
i. X-Ray (as specified)
j. EKG

7.5.1 Special Circumstances

There are no additional medical specific criteria for this project.

7.6 *Emergency Medical Assistance and First Aid*

Prior to work start-up, an emergency medical assistance network will be established. The Fire Department, ambulance service, and clinic or hospital emergency room are identified. A vehicle will be available on-site to transport injured personnel to the identified emergency medical facility. A first aid kit, including necessary protection against bloodborne pathogens, will be available. An adequate supply of fresh potable water for emergency eye wash purposes or portable emergency eyewash will be available. The emergency response number "9-1-1" will be used to expedite transport in the event of an emergency incident. A map and directions indicating the fastest route to San Francisco General Hospital (Figure -1) is located at the end of this document. A copy of the map will be posted in each vehicle.

8.0 RADIATION DOSIMETRY

Radiological hazards are not anticipated for this project.

9.0 EXPOSURE MONITORING/AIR SAMPLING PROGRAM

9.1 *Exposure Monitoring*

Based on the hazards anticipated during this project, no real-time or time-integrated monitoring will be conducted. The limited potholing will occur in areas with moist soil, so no dust generation is anticipated. However should this become an issue, water spray will be used to minimize dust generation.

9.2 *Heat or Cold Stress*

Heat or cold stress will be monitored qualitatively.

10.0 HEAT / COLD STRESS MONITORING

10.1 *General*

Heat and /or cold stress monitoring protocols will be implemented, as appropriate.

10.2 *Heat Stress*

The stress of working in a hot environment can cause a variety of illnesses including heat exhaustion or heat stroke; the latter can be fatal. Use of personal protective equipment can significantly increase heat stress. To reduce or prevent heat stress, SPK will, as required when ambient temperatures exceed 70 degrees Fahrenheit, implement scheduled rest periods and require controlled beverage consumption to replace body fluids and salts.

10.2.1 Monitoring for Heat Stress

Personnel will be trained to recognize the symptoms of heat stress and the appropriate action to take upon recognition. Even though physiological monitoring is not always necessary, it is essential that personnel understand the significance of heat stress and its recognition. The NIOSH/OSHA/USCG/EPA, Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, as well as the ACGIH® Threshold Limit Values and Biological Exposure Indices publication, provides protocols for prevention of heat stress.

10.3 *Cold Stress*

Cold stress may be an occupational stress. Frostbite and hypothermia are the primary concerns. To reduce or prevent cold stress, work practices will be implemented to reduce the risk of injury due to frostbite or hypothermia when ambient temperatures are below 40 degrees Fahrenheit. Personnel will be trained to recognize the symptoms of cold stress and take appropriate action.

11.0 STANDARD OPERATING SAFETY PROCEDURES, ENGINEERING CONTROLS AND WORK PRACTICES

SPK will develop and implement applicable and feasible engineering and work practice controls to reduce safety and health hazards. SPK will develop and implement, as applicable, standard operating procedures (SOP), to include but not limited to:

a. Site rules/prohibitions (buddy system, eating/drinking/smoking restrictions).
b. Work permits requirements (none anticipated)
c. Material handling procedures (duff).
d. Drum/container handling procedures and precautions (not anticipated).
e. Confined space entry procedures (not applicable).
f. Hot work, sources of ignition, fire protection/prevention (not applicable).
g. Electrical safety (ground-fault protection, overhead power line avoidance).
h. Excavation and trenching safety.
i. Guarding of machinery and equipment.
j. Lockout/Tagout.
k. Fall protection, (not anticipated).
l. Hazard Communication.
m. Illumination (work will be conducted during daylight hours).
n. Sanitation (existing facilities).
o. Engineering controls.
p. Process Safety Management (not applicable).
q. Signs and labels.

11.1 *Drugs and Alcohol*

No consumption of alcoholic beverages or illegal drugs will be allowed on site.

11.2 *Field Safety Requirements*

Field safety requirements and procedures applicable to this project include safe work practices, work zones, site control, safety meetings, safety inspections, accident reporting and investigations, sanitation, and housekeeping.

11.2.1 Excavation

Entry into an excavation deeper than four feet is not permitted under this SSHP.

11.2.2 Confined Space

Confined space entry is not permitted under this SSHP. The storage rooms at Battery Chamberline are not considered confined spaces but will be ventilated prior to entry.

11.2.3 Hearing Conservation

A hearing conservation program will be implemented when noise exposures equal or exceed an 8-hour TWA of 85 A-weighted decibels (dBA). Audiometric testing is part of the medical surveillance program. Personnel working within 25 feet of heavy equipment will wear hearing protection.

11.2.4 Sanitation

Existing bathroom facilities are located near the sites. Work breaks, eating, and drinking will be in the field vehicle or other suitable location outside the restricted area.

11.2.5 Fire Prevention and Protection

Smoking is not permitted in the restricted work area. The UXO Safety Specialist will designate a smoking area. A fire extinguisher will be available in the Corps of Engineers vehicle.

11.2.6 Manual Material Lifting

Material handling tasks pose a significant injury hazard to workers. Care will be taken when lifting and handling heavy or bulky items to prevent back injuries.

11.2.7 Weather

Activities will be suspended during severe weather conditions.

11.2.8 Slips, Trips, Falls

These potential hazards are likely due to slippery surfaces and uneven terrain. SPK personnel will watch where they walk.

11.2.9 Cuts and Scrapes

The potential for jagged-edged objects and general cuts and scrapes exist. SPK personnel will wear appropriate PPE.

11.2.10 Illumination

Work will be conducted during the daylight hours.

11.2.11 Heavy Equipment Operation

The hazards associated with the operation of heavy equipment include injury to personnel, equipment damage, and/or property damage. All heavy equipment will be operated in the manner in which it was intended and according to manufacturer's instructions. Only authorized personnel will be allowed near operating of heavy equipment and will maintain visual communication with the operator. Personnel will approach operating equipment only from the operator's angle of view and only after making eye contact with the operator. Personnel will wear reflective traffic vests.

12.0 SITE CONTROL MEASURES

12.1 *Work Zones*

Temporary barricades will be installed during the work in the 1918 West Cantonment Trench System to prevent those using hiking trails from exposure to physical hazards such as vegetation clearing and potholing. The barricades will direct hikers to detour around the site. The field team will cover open excavations with plywood or other material when not under the direct control of the field team. Excavations will be identified and protected in accordance with EM 385-1-1. Streamers, attached to a stationary object, will be used to monitor wind direction during excavation operations. Presidio Trust biologists will be invited to observe all phases of work to ensure that no endangered species are inadvertently disturbed.

An exclusion zone for CWM/MEC/UXO is not required as the probability of encountering MEC/UXO is assessed as "Low" and the probability of encountering CWM is "Seldom" or "Unlikely". However, a safety work zone for heavy equipment operations will be established. This safety work zone is defined as a 50-foot radius around any heavy equipment that is operating. During excavation activities only the OE Safety Specialist, essential personnel and equipment operators will be permitted in the safety zone.

In addition to the hazards posed by potential MEC/UXO, all personnel must remain alert for signs of HTRW/CWM contamination. Suspicious odors stained or discolored soils and unknown substances require immediate termination of excavation activities. The USACE team and equipment operators shall evacuate to a position upwind of the excavation. The USACE team will evaluate and notify appropriate authorities as the situation dictates.

12.2 *Site Security*

The TTL will coordinate work activities with the BEC, Presidio Trust and National Park Service.

12.3 *Authorized Personnel*

Only authorized personnel will enter regulated areas associated with the field activities. The OE Safety Specialist / SSHO will establish the bounds of the regulated areas. All workers entering the regulated areas will be subject to the provisions of the SSHP. A site Visitor's Logbook will be maintained.

12.3.1 Public Access

The site is accessible to the public (heavily trafficked by joggers and hikers); work will stop if the general public enters the regulated area.

12.4 *Communication Systems*

The OE Safety Specialist / SSHO will have a cell phone for off-site emergency responders.

12.5 *Contingencies for Presence of CWM*

In the event suspect CWM is encountered (item with "unknown filler"), all work will immediately cease and project personnel will be evacuated along cleared paths upwind from the discovery. A continuous, uninterrupted vehicle horn will be sounded for approximately 15 seconds to designate a site evacuation. The OE Safety Specialist / SSHO will access the need to notify or evacuate any additional areas within proximity of the discovery. A team consisting of a minimum of two personnel shall immediately secure the area to prevent unauthorized access. Personnel should position themselves as far upwind as possible while still maintaining security of the area. Two personnel will continue to secure the site until relieved by an EOD or the 20th Support Command (Formerly Technical Escort Unit [TEU]). The OE Safety Specialist / SSHO will immediately initiate response actions and simultaneously notify appropriate authorities.

a. All work will stop.
b. The OE Safety Specialist / SSHO will clear all personnel from the site and notify the U.S. Army Chemical Warfare Design Center at Huntsville, Alabama. The Chemical Warfare Design Center will notify the closest Explosives Ordnance Detachment (EOD) to the Presidio, i.e., the 787th EOD at Moffett Field, California (650) 603-8301, or the next closest EOD, the 60th EOD at Travis Air Force Base (707) 424-2040.
c. EOD will make a preliminary assessment of the discovery of CWM.
d. EOD will notify the 20th Support Command. The 20th Support Command will make the detailed assessment regarding the discovery of CWM.
e. The 20th Support Command and other appropriate U.S. Army offices will coordinate on implementing the Interim Guidance for Non-Sotckpile Chemical Warfare Materiel Response Activities.
f. Should CWM be confirmed, the U.S. Army Chemical Warfare Design Center will submit a Chemical Event Report.

Work will resume only after The 20th Support Command has conducted a full investigation or removal of CWM in the area.

13.0 PERSONAL HYGIENE AND DECONTAMINATION

Disposable wipes will be available to wash hands, face, other exposed skin surfaces, and hand tools. A formal decontamination station is not applicable for Level D activities, but PPE, in particular Tyveks used for poison oak protection, will be removed when the worker leaves the regulated areas. Disposable PPE will be placed in trash bags and disposed of in trash receptacles. Should the hazard conditions change and formal decontamination become necessary, the OE Safety Specialist / SSHO will notify the IH and an amendment to this SSHP will be required. Emergency decontamination is not anticipated.

14.0 EQUIPMENT DECONTAMINATION

Equipment that may require decontamination includes tools and sampling equipment. Any equipment used during the investigation will be brush-cleaned and wiped-down with disposable wipes. Disposable clothing, tools, buckets, brushes, and other equipment that is contaminated, as well as materials and equipment used for decontamination will be secured in appropriate containers.

14.1 *Decontamination of Heavy Equipment*

SPK will not use heavy equipment on this project.

15.0 EMERGENCY EQUIPMENT AND FIRST AID REQUIREMENTS

Potential on-site emergencies are expected to be restricted to minor fires or injuries to site personnel. On-site conditions are expected to be within the limits of measures that can be taken by on-site personnel. Any emergency that poses a potential threat to the public will be considered a situation requiring outside assistance from emergency response agencies. During any on-site emergency, work will cease until the emergency is brought under control.

The following items, as appropriate, will be available for on-site use:

a. First aid equipment and supplies.
b. Emergency eyewashes (ANSI Z-358.1).
c. Fire extinguishers.

16.0 EMERGENCY RESPONSE AND CONTINGENCY PROCEDURES (ON-SITE AND OFF-SITE)

16.1 *General*

Emergency response procedures specific to this project, including telephone numbers for the closets medical facilities capable of providing emergency service for hazardous waste site workers, a map showing the locations of these medical facilities. Additionally, telephone numbers for the Poison Control Center, local police, fire department (including emergency rescue squad), and SPK management contacts have been provided. The OE Safety Specialist / SSHO will be responsible for taking necessary action and contacting the appropriate emergency contacts and SPK personnel in case of emergency. SPK personnel will be prepared to respond and act quickly in the event of an emergency. Pre-planning measures will include employee training, fire and explosion prevention and protection, chemical spill and discharge prevention and protection, and safe work practices to avoid personal injury or exposure.

16.2 *Local Fire / Police / Rescue*

Local fire/police/rescue authorities having jurisdiction and nearby medical facilities that could be utilized for emergency treatment of injured personnel will be contacted to notify them of upcoming site activities and potential emergency situations, to ascertain their response capabilities, and to obtain a response commitment.

16.3 *Spill and Discharge Control*

Not applicable for this project.

16.4 *Fire Prevention Program*

Smoking is not allowed in the regulated area at any time. SPK site personnel will be trained in the general principles of fire extinguisher use and the hazards involved with

initial stage fire fighting. No fires will be fought where SPK personnel may be in imminent danger; the local fire department will be immediately notified.

16.5 *Personnel Roles/Lines of Authority*

The OE Safety Specialist / SSHO will direct all emergency response activities, assure all emergency contacts and notifications are made, and complete an incident report. The PM, IH and SO will be notified immediately in the event of an emergency.

16.5.1 Medical Emergency Response

In the event of severe physical or chemical injury, the OE Safety Specialist / SSHO will contactor emergency responders. The emergency medical responders will be utilized to provide care to severely injured personnel. Hospital location maps will be posted in each vehicle prior to the initiation of on-site activities. Any potential RCWM exposures will be treated at San Francisco General Hospital, other injuries can be treated at California Pacific Medical Ctr.

16.5.2 Emergency Response Contacts

Project Manager	Bruce Handel	(916) 557-7906
Technical Team Leader	Bradley Call	(916) 557-6649
OE Safety Specialist / SSHO	Thomas Knapp	(916) 557-7313
	Cell Phone	(916) 752-0354
Industrial Hygienist	David E Elskamp	(916) 557-7903
Chief SO	A.R. Smith	(916) 557-6973
Public Health Service (DFOH)	Marion Conley, RN	(916) 930-2290
Occupational Physician (DFOH)	Dr. Lee Wugfoski, MD	(415) 556-2975

San Francisco General Hospital
1001 Potrero Ave.
San Francisco, CA
(415) 206-8000

California Pacific Medical Ctr.
3700 California St
San Francisco, CA
(415) 600-6400

Poison Control Center	(800) 222-1222
Fire/Police Emergency	911
National Response Center Oil/Chemical Spills	1-800-424-8802

16.5.3 Personal Exposure or Injury

The OE Safety Specialist / SSHO will call for emergency assistance if needed. As soon as practical, the OE Safety Specialist / SSHO will contact the Section Supervisor. Staff assigned to this project will be briefed on procedures.

17.0 ACCIDENT PREVENTION

17.1 *Daily Safety and Health Inspections*

Daily safety and health inspections will be conducted to determine if site operations are in accordance with the approved SSHP, OSHA, and USACE requirements.

17.2 *Accident or Incident*

In the event of an accident or incident, the OE Safety Specialist / SSHO will immediately notify the PM and the employee's supervisor. Within three working days of any reportable accident/injury/illness, the employee and their supervisor will complete and submit to the SO and or Human Resources (HR) an Accident Report on ENG Form 3394, CA-1 and/or CA-2, and other applicable forms. The PM will complete and submit DA Form 285 for all Class A and B accidents.

17.3 *Accident Investigations*

All injuries, occupational illnesses, vehicle accidents, and incidents with potential for injury or loss will be investigated and appropriate corrective measures taken to prevent recurrence.

18.0 LOGS, REPORTS, AND RECORDKEEPING

The following logs, reports, and records will be developed, retained, and submitted to the PM:

a. Training logs (site-specific and visitor).
b. Daily safety inspection logs (may be part of the Daily QC Reports).
c. Employee/visitor register.
d. Environmental and personal exposure monitoring/sampling results.

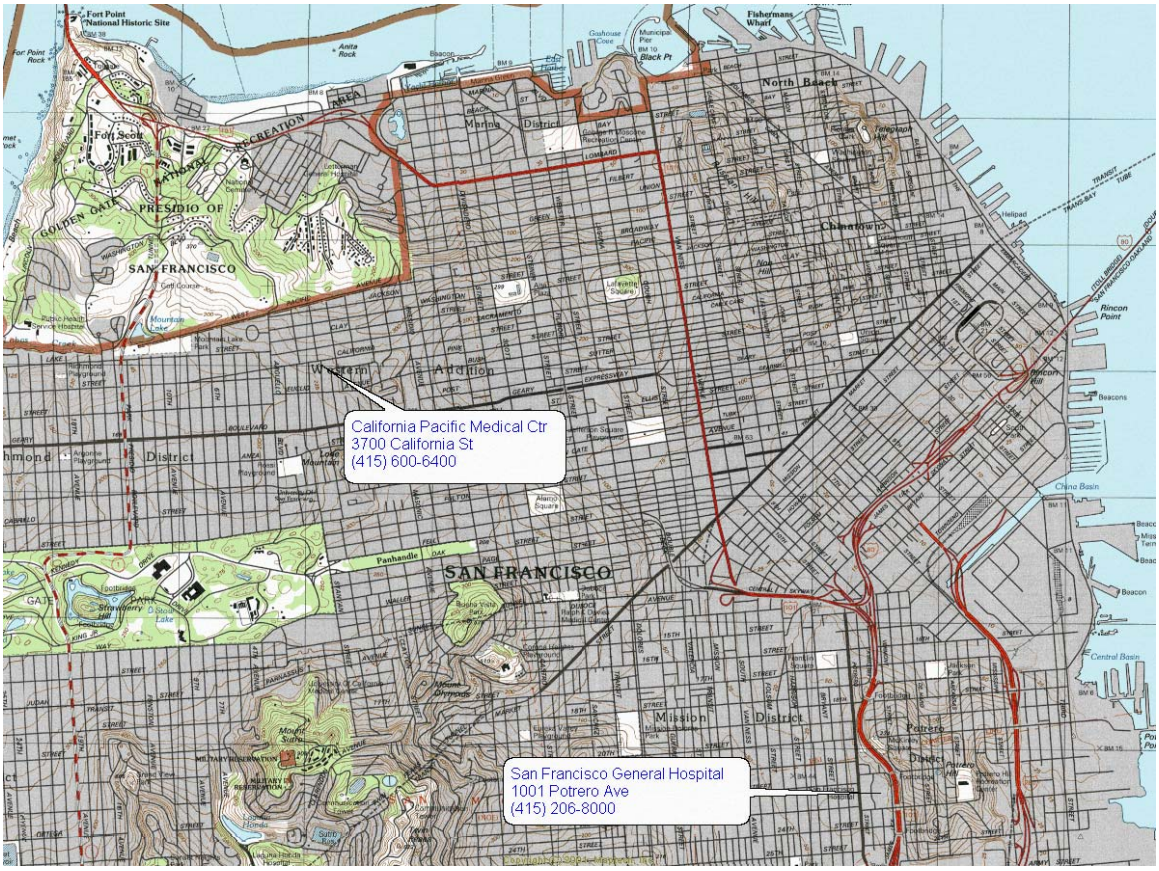
18.1 *Record Keeping*

The PM will maintain reports generated by the TTL or OE Safety Specialist / SSHO.

18.2 *Accident Reporting and Investigation*

SPK personnel are required to report all near misses, injuries, illnesses, and accidents to the OE Safety Specialist / SSHO and their immediate supervisor.

Figure - 1



San Francisco General Hospital
1001 Potrero Ave
(415) 206-8000

California Pacific Medical Ctr.
3700 California St
(415) 600-6400

Directions to San Francisco General Hospital:

Depart Presidio of San Francisco on Lincoln Blvd
Left onto Presidio Blvd (0.1 mile)
Left onto Lombard St (0.4 mile)
Right onto US-101 (Lombard St) (0.1 mile)
Right onto Divisadero St (1.1 mile)
Left onto Geary Blvd (0.8 mile)
Road name changes to O'Farrell St (0.2 mile)
Right onto US-101 (Van Ness Ave) (0.6 mile)
Left onto Fell St (0.1 mile)
Road name changes to 10th St (0.8 mile)
Right onto Potrero Ave (1.0 mile)
Left onto 23rd St (0.1 mile)
Left onto Local roads (s) (0.1 mile)

ACTIVITY HAZARD ANALYSIS

ACTIVITY: Contractor Oversight and Project QA

Principal Steps	Potential Hazards	Recommended Controls
1. Site investigation for the presence of chemical agent identification set material or chemical warfare materiel residues. Selective removal of vegetation, raking forest duff out of trenches, check for CAIS material, soil and swipe sampling for chemical agent break-down products, OE construction support 2. A Contractor may assist with vegetation removal and excavations of potholes (using a backhoe). 3. Oversight and Project QA	Chemical Hazards: Chemical Warfare Materiel, in particular HD, chemical warfare agent break-down products, and simulants. Radiological Hazards: None anticipated Biological Hazards: Snakes, poison oak, insects, spiders, tics Physical Hazards: 1. Cuts, scrapes, and pinch points from equipment 2. Slip/trip/fall on slippery surfaces and uneven terrain 3. Heat/cold stress, sun burns 4. Noise from heavy equipment 5. Struck by or against a piece of heavy equipment 6. Contact with overhead and underground utilities. 7. Excavation wall collapse. 8. Struck by backhoe.	Chemical Hazards 1. Level D PPE. 2. MSDSs for fuels for small equipment; no sample preservatives anticipated. 3. If CWM is encountered or suspected, all work will stop. Radiological Hazards: None Biological Hazards: Be aware of environment, PPE, and insect repellants. Physical Hazards 1. Guards must be place around moving equipment parts. 2. Watch where you step, be aware that leaves and grass, causing you to trip, can conceal sticks, rocks or other items. 3. Only qualified and trained personnel will operate equipment. 4. Equipment must be inspected by a competent person and operated in accordance with the manufacturer's instructions. 5. Moving equipment must have properly functioning back-up alarms. 6. Equipment shall not run unattended. 7. Hearing protection will be worn at 85 dBA. 8. Frequent breaks and replacement fluids to prevent heat stress. 9. Never walk or work directly in back or to the side of heavy equipment without the operator's knowledge. 10. Practice safe lifting 11. Drivers will have a valid driver's license and will wear a seat belt at all times. 12. Use the correct tools for the job. 13. Workers will not enter excavations at any time.
Equipment to be Used	**Inspection Requirements**	**Training Requirements**
1. The contractor may use a backhoe. 2. Hand tools, small power tools such as chainsaws and weed-wackers, small tractor. The OE Safety Specialist may use a hand-held magnetometer.	1. The SSHO will conduct daily site safety inspections.	1. HAZWOPER 40-hour initial training, plus 8-hour refresher within the past 12 months. 2. Initial site indoctrination training. 3. Daily tailgate safety meetings. 4. Hazard Communication training for any hazardous materials brought to the jobsite. 5. First Aid/CPR

EMPLOYEE ACKNOWLEDGMENT

This project requires the following: that you be provided with and complete formal and site-specific training; that you be supplied with proper personal protective equipment including respirators; that you be trained in its use; and that you receive a medical examination to evaluate your physical capacity to perform your assigned work tasks, under the environmental conditions expected, while wearing the required personal protective equipment. These things are to be done at no cost to you. By signing this certification, you are acknowledging that the Corps of Engineers has met these obligations to you.

I have reviewed, understand and agree to follow this Site Safety and Health in addition to the Contractor's SSHPs.

Printed Name	Signature	Organization	Date

TRAINING ACKNOWLEDGMENT FORM

By signing this certificate, you are acknowledging that you have completed the following formal training:

SITE-SPECIFIC TRAINING: I have completed the SPK/contractor site-specific training
_____Employee Initials

RESPIRATORY PROTECTION: I have been trained in accordance with SPK's Respiratory Protection Program, SPK OM 385-1-1. I have been trained in the proper work procedures and use and limitations of the respirator(s) I will potentially wear. I have been trained in and will abide by the facial hair policy. SPK employees will evacuate the site if conditions require an upgrade to EPA/OSHA Level B or A PPE (which includes respiratory protection).
_____Employee Initials

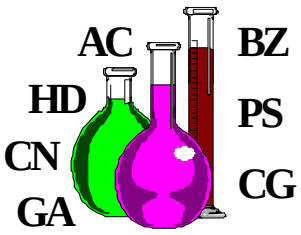
MEDICAL EXAMINATION: I have had a medical examination within the last [twelve months] [two years], which was paid for by the Corps of Engineers. The examination included: health history, pulmonary function tests and may have included an evaluation of a chest x-ray. A physician made a determination regarding my physical capacity to perform work tasks on the project while wearing protective equipment including a respirator. I was personally provided a copy and informed of the results of that examination. The Chief of SO Office evaluated the medical certification provided by the physician. The physician determined that there:

a. Were no limitations to performing the required work tasks;
   _____ Employee Initials
b. Were identified physical limitations to performing the required work tasks?
   _____ Employee Initials

Employee's Signature _____ Date _____

Employee's Name _____
(Printed)

U.S. Army Center for Health Promotion and Preventive Medicine

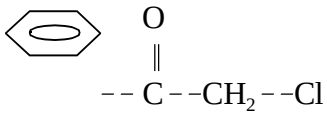


Detailed Facts About Tear Agent 2-Chloroacetophenone (CN)

218-19-1096

Physical Properties of Tear Agent 2-Chloroacetophenone

Chemical Structure



Chemical Formula	$C_6 H_5 COCH_2 Cl$
Description	CN is a colorless-to gray crystalline solid with a sharp, irritating floral odor. The odor threshold for CN is 0.1 mg/m^3.
Molecular Weight	154.60
Boiling Point	247°C
Vapor Pressure (mm Hg)	0.0026 @ 0°C 0.0041 @ 20°C 0.152 @ 51.7°C
Freezing Point	54°C
Density	Solid = 1.318 @ 20°C Liquid = 1.187 @ 58°C Vapor = 5.3 (air = 1)
Solubility	Insoluble in water
Flash Point	118°C

Agent CN - The chemical chloroacetophenone, Chemical Abstract Service Registry No. 532-27-4.

Volatility	2.36 mg/m^3 @ 0°C 34.3 mg/m^3 @ 20°C 1060 mg/m^3 @ 51.7°C	
Toxicity Values	ICt_{50}	= 80 mg-min/m^3
	LCt_{50}	= 7,000 mg-min/m^3 from solvent = 14,000 mg-min/m3 from grenade
	RfC (inhalation)	= 0.00003 mg/m^3

Exposure Limits

Workplace Time-Weighted Average -	0.3 mg/m^3
General Population Limits -	0.00003 mg/m^3

Toxic Properties of Chloroacetophenone

The United States considers agent CN (popularly known as mace or tear gas) and its mixtures with various chemicals to be obsolete for military deployment. It is highly toxic by inhalation and ingestion.

Overexposure Effects

Alpha-chloroacetophenone vapors may cause a tingling or runny nose, burning and/or pain of the eyes, blurred vision, and tears. Burning in the chest, difficult breathing, and nausea may also occur as well as skin irritation, rash, or burns. It can also cause difficulty if swallowed.

Emergency and First Aid Procedures

Inhalation: remove the victim to fresh air immediately; perform artificial respiration if breathing has stopped; keep victim warm and at rest; seek medical attention immediately.

Eye Contact: wash eyes immediately with copious amounts of water, lifting the lower and upper lids occasionally; do not wear contact lenses when working with this chemical; seek medical attention immediately.

Skin Contact: wash the contaminated skin using soap or mild detergent and water immediately; remove the contaminated clothing immediately and wash the skin using soap or mild detergent and water; seek medical attention immediately when there are chemical burns or evidence of skin irritation.

Ingestion: induce vomiting by having victim touch the back of the throat with finger or by giving victim syrup of ipecac as directed; do not induce vomiting if victim is unconscious; seek medical attention immediately.

Protective Equipment

Protective Gloves:	Wear impervious gloves.
Eye Protection:	Wear dust- and splash-proof safety goggles where there is any possibility of solid CN or liquids containing CN may contact the eyes; wear face shield; wear appropriate protective mask.
Other:	Wear a complete set of protective clothing to include gloves and lab coat, apron, boots, plastic coveralls; other protective clothing and equipment should be available to prevent contact with skin or clothing; remove contaminated clothing immediately; do not wear clothing until it has been properly laundered.

Reactivity Data

Stability:	Stable in closed containers at room temperature under normal storage and handling conditions.
Incompatibility:	Water or steam.
Hazardous Decomposition:	Toxic and corrosive vapors are produced when combined with water or steam.
Persistency	Short because the compounds are disseminated as an aerosol.

References

1. Code of Federal Regulations, Part 1910.1000, Title 29, (29 CFR 1910.1000), *Air Contaminants,* 1994.

2. Department of the Army Field Manual (DA FM) 3-9, *Potential Military Chemical/Biological Agents and Hazardous Chemicals,* 1990.

3. Department of the Army Technical Manual (DA TM) 3-250, *Storage, Shipment, Handling, and Disposal of Chemical Agents and Hazardous Chemicals,* 1969.

4. Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices for 1995-1996, American Conference of Governmental Industrial Hygienists (ACGIH), Cincinnati, Ohio.

5. Genium's Reference Collection, *Material Safety Data Sheet No. 603, 2-Chloroacetophenone,* Genium Publishing Corporation, Schenectady, New York, 1986.

6. U.S. Army Chemical Command Materiel Destruction Agency, *Site Monitoring Concept Study,* 15 September 1993.

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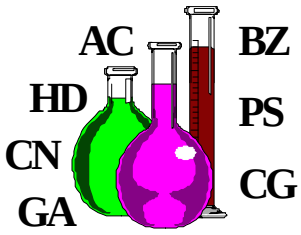
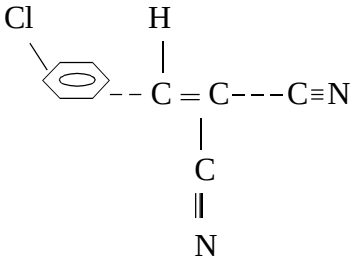


Detailed Facts About Tear Agent O-Chlorobenzylidene Malononitrile (CS)

218-23-1096

Physical Properties of Tear Agent O-Chlorobenzylidene Malononitrile

Chemical Structure



Chemical Formula	$C_{10}\ H_5\ Cl\ N_2$
Description	CS is a white crystalline solid; burnt to create a colorless gas with an acrid pepperlike smell.
Molecular Weight	188.5
Boiling Point	310°C to 315°C
Vapor Pressure (mm Hg)	3.4×10^{-5} @ 20°C
Freezing Point	93°C to 95°C
Density	Solid = 1.04 g/cc Vapor - several times heavier than air
Solubility	Soluble in hexane, benzene, methylene chloride, acetone, dioxane, ethyl acetate, and pyridine; insoluble in water and ethanol.
Flash Point	197°C

Agent CS - The chemical o-chlorobenzylidene malononitrile, Chemical Abstract Service Registry No. 2698-41-1.

Volatility 0.71 mg/m^3 @ 25°C

Toxicity Values ICt_{50} = 10 to 20 mg-min/m^3
LCt_{50} = 61,000 mg-min/m^3

Exposure Limits

Workplace Time-Weighted Average - 0.4 mg/m^3
General Population Limits - No standard identified

Toxic Properties of O-Chlorobenzylidene Malononitrile

CS was developed in the late 1950s as a riot-control substance. It is a more potent irritant than chloroacetophenone but less incapacitating. In the late 1960s, stocks of CS replaced CN. Presently, the U.S. Army uses CS for combat training and riot control purposes.

Overexposure Effects

CS is disseminated by burning, explosion, and aerosol formation. It is immediately irritating to the eyes and upper respiratory tract. Warm vapors mix with human sweat to cause a burning sensation to the eyes, nose, and mouth. Conjunctivitis and pain in the eyes, lacrimation, erythema of the eyelids, runny nose, burning throat, coughing and constricted feeling in the chest are the effects which will occur immediately and will persist 5 to 20 minutes after removal from the contaminated area.

It is immediately dangerous to life and health at a concentration of 2 mg/m^3. It is not an accumulative agent in the human body, although it accumulates in the landscape. CS is the most persistent of the tear agents, absorbing into the most porous surfaces including soil and plaster.

Emergency and First Aid Procedures

Inhalation: remove the victim to fresh air immediately; perform artificial respiration if breathing has stopped; keep the victim warm and at rest; seek medical attention immediately.

Eye Contact: wash eyes immediately with copious amounts of water for at least 15 minutes; apply an ophthalmic corticosteroid ointment after decontamination; treat delayed erythema with a bland shake lotion (such as calamine lotion) or a topical corticosteroid depending on severity; do not wear contact lenses when working with this chemical; seek medical attention immediately.

Skin Contact: wash the contaminated skin thoroughly using soap and water; remove the contaminated clothing immediately; if irritation persists after washing, seek medical attention immediately.

Ingestion: give victim copious amounts of water immediately; induce vomiting by having victim touch the back of throat with finger; do not make an unconscious person vomit; seek medical attention immediately.

Protective Equipment

Protective Gloves:	Wear impervious gloves; rubber gloves.
Eye Protection:	Wear face shields or dust- and splash-proof safety goggles to prevent any possibility of skin contact.
Other:	Wear protective mask and overclothing in confined spaces; use a chemical cartridge respirator with organic vapor cartridges in combination with a high efficiency particulate filter; wear a self-contained breathing apparatus with a full face piece or an air purifying, full-face piece respirator with an organic vapor canister.

Do not use standard decontaminants or detergents that contain chlorine bleach because the materials can react to form compounds more toxic than CS. Contaminated surfaces should be decontaminated using a solution of equal parts (by volume) methanol and water with 18 percent (by weight) sodium hydroxide or commercial lye added to the solution. Also, an aqueous solution containing 10 percent monoethanolamine anionic detergent can be used as a decontaminant.

Reactivity Data

Stability:	Stable in storage.
Incompatibility:	Incompatible with strong oxidizers.
Hazardous Decomposition:	When heated to decomposition, CS emits very toxic fumes.
Hydrolysis Products:	AQ Alkaline.
Persistency	Varies, depending upon amount of contamination.

References

1. Department of the Army Field Manual (DA FM) 3-9, *Potential Military Chemical/Biological Agents and Compounds,* 1990.

2. *The Merck Index, An Encyclopedia of Chemicals, Drugs, and Biologicals, Eleventh Edition,* Merck & Co., Inc., Rahway, New Jersey, 1989

3. *Hazardous Substances Data Bank,* January 1996.

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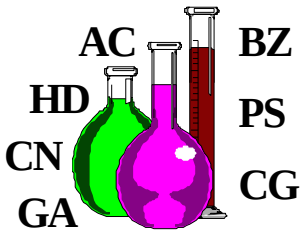

Detailed Facts About Sulfur Mustard Agents H and HD

218-08-1096

Physical Properties of Sulfur Mustard HD

Chemical Structure	$ClCH_2CH_2$-S-CH_2CH_2Cl
Chemical Formula	$C_4(H_8)C_{12}(S)$
Description	Mustard agent *liquid* is colorless when pure, but it is normally a yellow to brown oily substance. Mustard agent *vapor* is colorless with a slight garlic- or mustard-like odor.
Molecular Weight	159.08
Vapor Pressure (mm Hg)	0.072 @ 20°C 0.11 @ 25°C
Boiling Point	215-217°C; slowly vaporizes at ordinary temperatures.
Freezing Point	14.5°C
Density	Liquid = 1.27 Vapor = 5.4 (air = 1)
Solubility	Very sparingly soluble in H_2O; freely soluble in animal oils, fats, organic solvents.

Agent HD - The chemical Distilled mustard or bis(2-chloroethyl) sulfide; HD is H that has been purified by washing and vacuum distillation to reduce sulfur impurities, Chemical Abstract Service Registry No. 505-60-2.

Flash Point	105°C
Volatility	75 mg/m^3 @ 0°C (solid) 610 mg/m^3 @ 20°C (liquid) 2,860 mg/m^3 @ 40°C

Toxicity Values	ICt_{50} (eyes)	= 200 mg-min/m^3
	ICt_{50} (inhalation)	= 1,500 mg-min/m^3
	ICt_{50} (skin)	= 2,000 mg-min/m^3@70° to 80°F (humid environment)
		= 1,000 mg-min/m^3@90°C (dry environment)
	LCt_{50} (inhalation)	= 1,500 mg-min/m^3
	LCL_0 (inhalation, 10 min)	= 1,496 mg-min/m^3
	LD_{50} (skin)	= 100 mg/kg
	LD_{50} (oral)	= 0.7 mg/kg
	1% Lethality	= 150 mg-min/m^3
	No Deaths Level	= 100 mg-min/m^3
	NOAEL (inhalation)	= 1.4 mg-min/m^3

Exposure Limits

Workplace Time-Weighted Average -	0.003 mg/m^3
General Population Limits -	0.0001 mg/m^3

Toxic Properties of Sulfur Mustard

Mustard agents stored in the unitary stockpile are in ton containers, artillery shells, and other munitions. Stockpiled at Aberdeen Proving Ground, MD; Anniston Army Depot, AL; Blue Grass Army Depot, KY; Pine Bluff, AR; Pueblo Depot Activity, CO; Tooele Army Depot, UT; and Umatilla Depot Activity, OR.

Overexposure Effects

HD is a vesicant (blister agent) and alkylating agent producing cytotoxic action on the hematopoietic (blood forming) tissues, which are especially sensitive. The rate of detoxification of HD in the body is very slow, and repeated exposures produce a cumulative effect. The physiological action of HD may be classified as local and systemic. The local action results in conjunctivitis or inflammation of the eyes, erythema which may be followed by blistering or ulceration; inflammation of the nose, throat, trachea, bronchi, and lung tissue. Injuries produced by HD heal much more slowly and are more susceptible to infection than burns of similar intensity produced by physical means or by most other chemicals. Systemic effects of mustard may include malaise, vomiting, and fever, with onset time about the same as that of the skin erythema.

With amounts approaching the lethal dose, injury to bone marrow, lymph nodes, and spleen may result. HD has been determined to be a human carcinogen by the International Agency for Research on Cancer.

Emergency and First Aid Procedures

Inhalation: remove victim from the source immediately; administer artificial respiration if breathing has stopped; administer oxygen if breathing is difficult; seek medical attention immediately.

Eye Contact: speed in decontaminating the eyes is absolutely essential; remove person from the liquid source, flush the eyes immediately with water by tilting the head to the side, pulling the eyelids apart with the fingers, and pouring water slowly into the eyes; do not cover eyes with bandages; but if necessary, protect eyes by means of dark or opaque goggles; seek medical attention immediately.

Skin Contact: don respiratory protective masks and gloves; remove victim from agent source immediately; flush skin and clothes with 5 percent solution of sodium hypochlorite or liquid household bleach within 1 minute; cut and remove contaminated clothing; flush contaminated skin area again with 5 percent sodium hypochlorite solution; then wash contaminated skin area with soap and water; seek medical attention immediately.

Ingestion: do not induce vomiting; give victim milk to drink; seek medical attention immediately.

Protective Equipment

Protective Gloves:	MANDATORY - Wear Butyl toxicological agent protective gloves (M3, M4, gloveset).
Eye Protection:	Wear chemical goggles as a minimum; use goggles and face shield for splash hazard.
Other:	Wear gloves and lab coat with M9 or M17 mask readily available for general lab work. In addition, wear daily clean smock, foot covers, and head cover when handling contaminated lab animals.

Reactivity Data

Stability:	Stable at ambient temperatures; decomposition temperatures is 149°C to 177°C; can be active for at least three years in soil; stable for days-week, under normal atmospheric temperature; slowly hydrolyzed by water; destroyed by strong oxidizing agents.
Incompatibility:	Rapidly corrosive to brass @ 65°C; will corrode steel at

	.001 in. of steel per month @ 65°C.
Hazardous Decomposition:	Mustard will hydrolyze to form HCl and thiodiglycol.
Hazardous Polymerization:	Will not occur.
Persistency	Depends on munition used and the weather; heavily splashed liquid persists 1 to 2 days in concentration to provide casualties of military significance under average weather conditions, and a week to months under very cold conditions.

References

1. Department of the Army Pamphlet (DA PAM) 40-173, *Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to Mustard Agents H, HD, and HT*, 30 August 1991.

2. Department of the Army Field Manual (DA FM) 3-9, *Potential Military Chemical/Biological Agents and Compounds*, 1990.

3. Institute of Medicine, National Academy of Sciences, C.M. Pechura and D.P. Rall, eds., *Veterans at Risk: The Health Effects of Mustard Gas and Lewisite*, National Academy Press, Washington, D.C., 1993.

4. Papirmeister, B., et al., *Medical Defense Against Mustard Gas: Toxic Mechanisms and Pharmacological Implications*, Boca Raton, Florida: CRC Press, 1991.

5. U.S. Army Chemical Command Materiel Destruction Agency, *Site Monitoring Concept Study*, 15 September 1993.

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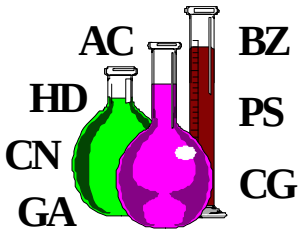

General Facts About Blister Agent Lewisite (L)

218-38-1096

General

L is a vesicant (blister agent); also, it acts as a systemic poison, causing pulmonary edema, diarrhea, restlessness, weakness, subnormal temperature, and low blood pressure. In order of severity and appearance of symptoms, it is: a blister agent, a toxic lung irritant, absorbed in tissues, and a systemic poison. When inhaled in high concentrations, it may be fatal in as short a time as 10 minutes. L is not detoxified by the body. Common routes of entry into the body include ocular, percutaneous, and inhalation.

Synonyms

Arsine, (2-chlorovinyl) dichloro-;
Arsonous, dichloride, (2-chloroethenyl)-;
Chlorovinylarsine dichloride;
2-Chlorovinyldichloroarsine;
beta-Chlorovinyldichloroarsine;
Dichloro (2-chlorovinyl) arsine;
L;
EA1034.

Description

Pure Lewisite is a colorless, oily liquid with very little odor. The plant sample (war gas) has a geranium-like odor and is an amber to dark brown liquid.

Overexposure Effects

Lewisite presents both a vapor and liquid hazard and may damage the eyes, skin, respiratory tract, and circulatory system. Exposure to L causes immediate (within 30 seconds) irritation or pain. The vapor may be inhaled into the respiratory tract, causing the immediate onset of burning pain, irritation of the nose, and reflex coughing and chest tightness. The vapor also affects the eyes, with the immediate onset of pain, redness, uncontrollable blinking, and swelling of the eyelids. The vapor or a liquid splash of L on the skin may cause immediate stinging pain and destruction of tissue, following by blistering within 12 hours.

Lewisite - The chemical chlorovinyldichloroarsine, Chemical Abstract Service Registry No. 541-25-3.

Emergency and First Aid Procedures

Inhalation: remove from the source immediately; give artificial respiration if breathing has stopped; administer oxygen if breathing is difficult; seek medical attention immediately.

Eye Contact: speed in decontaminating the eyes is absolutely essential; remove person from the liquid source; flush the eyes immediately with water for 10-15 minutes by tilting the head to the side, pulling eyelids apart with fingers, and pouring water slowly into the eyes; do not cover eyes with bandages, but if necessary, protect eyes by means of dark or opaque goggles; seek medical attention immediately.

Skin Contact: remove victim from source immediately and remove contaminated clothing; immediately decon affected areas by flushing with 10 percent sodium carbonate solution; wash off with soap and water after 3 to 4 minutes to protect against erythema; seek medical attention immediately.

Ingestion: do not induce vomiting; give victim milk to drink; seek medical attention immediately.

Storage of L

L is stored in ton containers (heavy steel cylinders) at one military installation on the continental United States - Tooele Army Depot, Utah.

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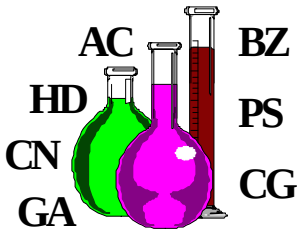

General Facts About Choking Agent Phosgene (CG)

218-25-1096

General

CG, normally a chemical agent with a short duration, was used extensively in World War I. More than 80 percent of World War I chemical agent fatalities were caused by CG.

Synonyms

Carbonyl chloride;
Carbon oxychloride;
Carbon dichloride oxide;
Carbon dichloride;
Carbonic acid dichloride;
Chloroformyl chloride.

Description

CG is a severe eye, mucous membrane, and skin irritant. It is highly toxic by inhalation. Two parts per million in air is immediately dangerous to life and health. Being a gas, it is primarily a toxic hazard by inhalation exposure. CG is foglike in its initial concentration but becomes colorless as it disperses. It has an odor of newly mown hay.

Overexposure Effects

Phosgene is a corrosive, highly toxic gas used as a delayed-casualty agent resulting in fluid buildup in the lungs ("dryland drowning"). It affects the upper respiratory tract, skin, and eyes and causes severe respiratory damage as well as burns to the skin and eyes. Acute inhalation may cause respiratory and circulatory failure with symptoms of chills, dizziness, thirst, burning of eyes, cough, viscous sputum, dyspnea, feeling of suffocation, tracheal rhonchi, burning in throat, vomiting, pain in chest, and cyanosis. CG is a severe mucous membrane irritant. Chronic inhalation may cause irreversible pulmonary changes resulting in emphysema and fibrosis. Acute skin contact may result in lesions similar to those of frostbite and burns; it is a severe skin irritant. Chronic skin contact may result in dermatitis. Acute eye contact may result in conjunctivitis, lacrimination, lesions similar to those of frostbite, and burns; chronic eye contact may result in conjunctivitis.

Agent CG - The chemical carbonyl chloride, Chemical Abstract Service Registry No. 0075-44-5.

Emergency and First Aid Procedures

Inhalation: remove victim to fresh air; keep individual calm and avoid any unnecessary exertion or movement; maintain airway and blood pressure; trained persons should administer oxygen if breathing is difficult; give artificial respiration if victim is not breathing; seek medical attention immediately.

Eye Contact: flush eyes immediately with running water or normal saline for at least 15 minutes; hold eyelids apart during irrigation; do not delay rinsing to avoid permanent eye injury; seek medical attention immediately.

Skin Contact: unlikely that emergency treatment will be required; gently wrap affected part in blankets if warm water is not available or practical to use; allow circulation to return naturally; if adverse effects occur, seek medical attention immediately.

Ingestion: treat symptomatically and supportively; if vomiting occurs, keep head lower than hips to prevent aspiration; seek medical attention immediately.

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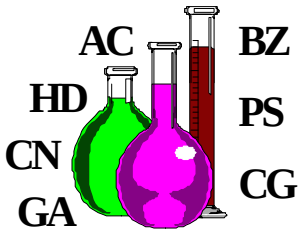

General Facts About Tear Agent Chloropicrin (PS)

218-46-1096

General

PS was used in large quantities during World War I; it was stockpiled during World War II and is no longer authorized for military use. PS is more toxic than chlorine but less toxic than phosgene (CG). PS is a severe respiratory irritant. Persons with impaired pulmonary function may be at increased risk from exposure. It is a possible but unconfirmed tumorigenic agent that decomposes to form toxic chlorine gas and nitrogen oxides near oxygen fires.

Synonyms

Nitrotrichloromethane;
Trichloronitromethane;
Nitrochloroform.

Description

PS is a colorless, oily liquid with a stinging pungent odor.

Overexposure Effects

Chloropicrin is a powerful irritant whose vapors cause lung, skin, eye, nose and throat irritation, coughing and vomiting. As an eye irritant, it produces immediate burning, pain and tearing. In high concentration, PS damages the lungs, causing pulmonary edema. Exposure to liquid PS can cause severe burns on the skin that generally result in blisters and lesions. The lowest irritant concentration is 9 mg-min/m^3 for 10 minutes, and the median lethal concentration is 2,000 mg-min/m^3.

Emergency and First Aid Procedures

Inhalation: remove the victim to fresh air immediately; perform artificial respiration if breathing has stopped; keep the victim warm and at rest; seek medical attention immediately.

Eye Contact: wash eyes immediately with copious amounts of water, lifting the lower and upper lids occasionally; do not wear contact lenses when working with this chemical; seek medical attention immediately.

Agent PS - The chemical chloropicrin, Chemical Abstract Service Registry No. 0076-06-2.

Skin Contact: wash the contaminated skin using soap or mild detergent and water; remove the contaminated clothing immediately; wash the skin using soap or mild detergent and water; if irritation persists after washing, seek medical attention immediately.

Ingestion: give victim copious amounts of water immediately; induce vomiting by having victim touch the back of his throat with his finger; do not make an unconscious person vomit; seek medical attention immediately.

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